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SIXTH ANNUAL MEETING

TRANSACTIONS OF THE

Minneapolis, St. Paul & Sault Ste. Marie Railway Surgical Association

Sixth Annual Meeting

Held at Duluth, Minn., October 10 and 11, 1912

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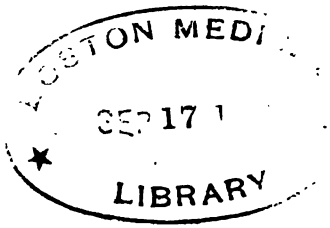

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H. JEFFERSON O'BRIEN - - Superior, Wis.

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CHARLES D'A WRIGHT, Chairman

JOHN H. RISHMILLER, Secretary

LEO M. CRAFTS HORACE G. MURDOCK

JUSTUS OHAGE

THE NEXT MEETING WILL BE

HELD ON

DECEMBER 4 and 5, 1913

AT THE HOTEL PFISTER

MILWAUKEE

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MINUTES OF THE SIXTH ANNUAL MEETING OF THE MINNEAPOLIS, ST PAUL AND SAULT STE. MARIE RAILWAY SURGICAL ASSOCIATION, THE SPALDING, DULUTH, MINN., OCTOBER 10 AND 11, 1912

OCTOBER 10, 9:30 O'CLOCK A. M.

The sixth annual meeting of the Minneapolis, St. Paul and Sault Ste. Marie Railway Surgical Association convened in The Hotel Spalding, Duluth, Minn., October 10, at 9:30 A. M., and was called to order by President Charles A. Stewart, Duluth, who then read his Presidential address.

It was moved by Dr. John H. Rishmiller that the chair appoint a committee of three to take definite action for the Association upon the President's Address, this committee to report at the business meeting on Friday.

Motion seconded. Carried.

The President announced that he would name the committee later in the day.

The first paper on the program, entitled "Fracture of the Patella," by Dr. Stephen E. Gavin, Fond du Lac, Wis., was then read. The paper was discussed by Drs. Albert J. Pullen, North Fond du Lac, Wis.; Rowland Gilmore, Bemidji; John H. Rishmiller, Minneapolis; and the essayist, closing the discussion.

A paper entitled "Traumatic Synovitis," by Dr. John J. Catlin, Buffalo, Minn., was read, and was dis-

cussed by Drs. H. Jefferson O'Brien, Superior, Wis.; Cyrus N. Callender, Fargo, N. D.; Frank S. Wiley, Fond du Lac, Wis.; Stephen E. Gavin; Louis A. Nippert, Minneapolis, Minn.; and Nicholas J. Shields, Lidgerwood, N. D.; Dr. Catlin closing the discussion.

The subject of "Early Recognition of Eye Injuries," pending the arrival of author of the last paper on the morning program, was discussed by Drs. John Steele Barnes, Milwaukee, Wis.; Charles D'a Wright, Minneapolis, Minn.; and George F. Scheib, Fond du Lac, Wis. The paper entitled "Eye Injuries and the Early Recognition of Dangerous Complications," by Dr. John H. Urquhart, Ironwood, Mich., was then read, and the discussion continued by Drs. Clarence E. Lum, Duluth, Minn.; Charles D'a Wright; and John Steele Barnes, the essayist, closing the discussion.

Meeting adjourned to 2 o'clock P. M.

October 10, 2 o'clock P. M.

The meeting was called to order by President Stewart, who then introduced Dr. Joseph C. Bloodgood, Associate Professor of Surgery, Johns Hopkins University, Baltimore, Md. Dr. Bloodgood delivered by invitation an oration on "Observation on Blood-Pressure Records Before, During and After Operation."

Questions for information were replied to by Dr. Bloodgood, in closing.

Upon motion by Dr. Leo M. Crafts, seconded by Dr. Rishmiller, a rising vote of thanks was unanimously extended to Dr. Bloodgood for his address.

In accordance with the announcement made at the morning session, the President appointed the following committee on the President's Address: Drs.

Stephen E. Gavin, Fond du Lac, Wis., chairman; George M. Steele, Oshkosh, Wis., and Fred J. Patton, Duluth, Minn.

A paper entitled "Duties of Local Surgeon Towards the Company and the Patient," by Dr. Conrad E. Nystrum, Medford, Wis., was read. This paper was discussed by Drs. Joseph C. Bloodgood and Alfred M. Ridgway, Annandale, Minn., the essayist, closing the discussion.

The next number of the program was a symposium on "Cranial Injuries," consisting of eight papers, three of which were read at this session, as follows:

"The Mechanism of Fractures," by Dr. Victor A. Mason, Marshfield, Wis.

"Concussion, Contusion, and Compression," by Dr. Nicholas J. Shields, Lidgerwood, N. D.

"Injuries of Cerebral Blood-Vessels," by Dr. Victor A. Young, Hankinson, N. D. (Paper read by Dr. Fred J. Patton, Duluth, Minn.)

Upon motion, the presentation of Dr. Crafts' paper was postponed to the morning session.

Meeting adjourned to 9 o'clock A. M.

October 11, 9 o'clock A. M.

The meeting was called to order by President Stewart. The remainder of the papers, comprising the symposium on "Cranial Injuries," were then read, as follows:

"Symptomatology of Organic Lesions Affecting Sensorimotor Areas," by Dr. Leo M. Crafts, Minneapolis, Minn.

"Ocular Manifestations in Cranial Injuries Not Affecting the Eyeball," by Dr. Charles D'a Wright, Minneapolis, Minn.

"Differential Diagnosis of Fracture of the Base of the Skull," by Dr. Theodor Bratrud, Warren, Minn.

"The Technic of Intracranial Operations," by Dr. Albert E. Halstead, Chicago. (Paper read by Dr. Roger T. Vaughan, Chicago.)

"Sequence of Cranial Injuries," by Dr. Leonard C. Weeks, Detroit, Minn.

This symposium on "Cranial Injuries" was discussed jointly by Drs. John H. Rishmiller, Clayton H. Charles, Roger T. Vaughan, John Steele Barnes, F. Gregory Connell, and Rowland Gilmore.

The meeting adjourned to 2 o'clock P. M.

OCTOBER 11, 2 O'CLOCK P. M.

Meeting was called to order by President Stewart. The following papers were then read:

"Fracture of Neck of Femur, with Especial Reference to Treatment," by Dr. Andrew Nelson, Manistique, Mich.

"Supracondyloid Fracture of Femur, and Treatment," by Dr. Alfred M. Ridgway, Annandale, Minn.

"Operative Treatment of Fracture of Femur," by Dr. George G. Eitel, Minneapolis, Minn.

These three papers were discussed jointly by Drs. George M. Steele, Frank S. Wiley, John H. Rishmiller, Fred J. Patton, Daniel D. Murray, Cyrus N. Callender, Theodor Bratrud, and Charles A. Stewart; Drs. Nelson, Ridgway, and Eitel closing the discussion.

The next paper was on "Injuries Described According to Anatomic Relations," by Dr. Jonas Rhodes Longley, Fond du Lac, Wis. The paper was discussed by Dr. F. Gregory Connell.

The scientific portion of the program being completed, the Association adjourned and immediately reconvened in business session.

It was moved by Dr. John Steele Barnes that a vote of thanks be extended to the Secretary for the work which he has put upon the very excellent program furnished. Motion seconded and carried.

Dr. Rishmiller responded by thanking the members who have given their time in presenting the program.

The report of the Treasurer was presented, and upon motion was accepted.

RECEIPTS

1911

Cash balance, October 17, 1911	$599.06
"Soo" Railway Company's appropriation towards publishing transactions	250.00
Dues for 1912 (161)	483.00
Exchange charges	3.10
	$1,335.16

DISBURSEMENTS

1911

October 17	
Drake Hotel Company,	
Seventy-seven dinners at $2.50	$192.50
Decorations	25.00
Music	18.00
Waiter service	9.50
November 6	
Honorarium, 1911, for Secretary-Treasurer	100.00
Honorarium, 1911, for Stenographer	50.00
November 28	
Miss Adelaide Folsom,	
To one-half of bill for reporting and transcribing proceedings of Association on Oct. 16 and 17, 1911	25.00
December 8	
Kohlstedt Printing Company,	
One-half of bill for 300 programs	7.50
December 13	
Hahn & Harmon Company,	
500 letter-heads (250 President, 250 Secretary-Treasurer)	5.50
Expressage to Duluth	.26

April 3 1912	
Railway Surgical Journal,	
Killed matter	4.25
August 10	
Postage for 1911 Transactions	14.00
September 4	
Press of Journal-Lancet, Minneapolis,	
500 copies Transactions, 1911, including engravings and illustrations	375.00
September 4	
Kohlstedt Printing Company,	
500 tension-envelopes and printing for Transactions	7.50
October 1	
Postage for programs	1.80
Bank exchange on checks for 1912	1.80
	$837.61
Cash in First National Bank, Minneapolis, Minn., October 11, 1912	$497.55

Respectfully submitted,

J. H. RISHMILLER, Treasurer.

Examined and approved:

HENRY L. ULRICH.

The report of Committee on Permanent Organization was presented by Dr. Gavin, as follows:

The committee appointed by the President to consider the desirability of a permanent organization, and the establishment of a Committee on Constitution and By-Laws, submits the following report:

We recommend that a committee of three be appointed by the President to draft a constitution and by-laws and perform other necessary duties to establish properly a permanent organization, said committee to report at our next annual meeting.

We further recommend that no action be taken on the increase of dues at the present time.

We further suggest that a copy of the address of our president, Dr. Charles A. Stewart, be submitted to the committee on organization, constitution and by-laws, and that his recommendations be carefully considered in drawing up by-laws for this Association.

STEPHEN E. GAVIN, Chairman.
FRED J. PATTON.
GEORGE M. STEELE.

Dr. Gavin further suggested that the incoming President appoint Dr. Charles A. Stewart as a member of this committee.

Upon motion the report of the committee was accepted and ordered placed on file.

Upon motion Milwaukee, Wis., was chosen as the meeting-place for next year.

Motion was made by Dr. Henry E. Combacker, Osceola, Wis., that any member of this Association who fails to attend three consecutive annual meetings of the Association, beginning with the meeting of 1912, shall be regarded as voluntarily resigning from membership in the Association. The motion was seconded, and carried.

The President announced that nominations for president for the ensuing year would now be made, whereupon Dr. Albert J. Pullen placed in nomination Dr. Frank S. Wiley, Fond du Lac, Wis. The nomination was duly seconded. Upon motion of Dr. Stephen E. Gavin the Secretary was instructed to cast the unanimous vote of the Association for Dr. Wiley as President for the ensuing year. Whereupon Dr. Wiley was declared to be duly elected.

Dr. Alfred M. Ridgway placed in nomination for vice-president, Dr. Alexander J. McCannel, Minot, N. D.

Dr. John Steele Barnes moved that the Secretary be instructed to cast the unanimous vote of the Association for Dr. McCannel as Vice-President for the ensuing year. Motion seconded, and carried.

The Secretary announced that he had so cast the vote, whereupon Dr. McCannel was declared duly elected.

Dr. Daniel D. Murray moved that Dr. Rishmiller be continued as Secretary-Treasurer for the ensuing year. Motion was seconded, and carried.

President Wiley: Fellow Members: I cannot express to you how deeply I appreciate the honor you have conferred upon me, and I shall endeavor, with the help of our worthy Secretary and also the members from Milwaukee, to make our next meeting the best that has ever been held by the "Soo" Surgical Association. I thank you one and all.

Upon motion, the meeting adjourned.

PRESIDENT'S ADDRESS

CHARLES A. STEWART, M. D.
DULUTH, MINNESOTA

Gentlemen: The measure of all human achievement may be summed up in a single word, Success. It does not matter to what undertaking the test is applied, the result is either success or failure. If the former, it may be concluded that the undertaking is meritorious and that its development has been entrusted to competent hands; while, if failure results, it is either because there was no manifest need for the undertaking or there has been mismanagement.

In applying such a test to this Association, taking as evidence the growth in membership, the general excellence of the papers submitted, together with the interest shown in their discussion, it would appear that there can be but one conclusion, namely, that the Association was needed and that its need, together with the objects to be attained through its successful development, was recognized by the organizers.

The objects of the Association may be said to be twofold. One is the extension of acquaintance, harmony, and good fellowship among the members, and I trust that this feature will be exploited by the Duluth-Superior members as fully as may be without interfering with the excellent and elaborate literary program which has been arranged by our Secretary, and which is, most properly, the essential feature of the meeting.

We fully appreciate the extent of mutual improvement that is attained through the expressions of opin-

ion and the interchange of ideas and experiences that come through discussion of the various subjects of general interest which are presented, and we recognize this medium as a means of securing individual betterment and augmented ability, which, in turn, lead to greater efficiency.

The present meeting is the fifth since the organization of the Association, and as it is the end of the first half decade of its existence it would seem a fitting time to consider, briefly, what has been accomplished by it in the past, what the present conditions are, and what, if anything, can be done at the present time to insure permanency of the organization and retain the interest shown in the meetings by the members.

As many of the members already know, the Association has grown from a small informal gathering at the first meeting, five years ago, to its present size. That the first meetings were more in the nature of social gatherings and were conducted for the purpose of bettering the surgical service of the road through extension of acquaintance, informal interchange of ideas, and co-operation in effort, was to be expected; but as time went on the membership grew in numbers, until at the present time there is an enrollment of about one hundred and sixty, and the desirability of a more definite organization becomes apparent.

With the membership at this point in numbers, the organization is purely informal in character and lacks both a constitution and by-laws to serve as a basis of government. The interest shown in the Association, as evidenced by the numbers in attendance, together with the high character of the papers offered, is the best of evidence that it is filling a definite need; and it would seem that the condition mentioned above should not continue longer, and I take this opportunity to recommend to you that measures be taken at this meeting to provide for the election or appointment of a

committee to draft a constitution and by-laws defining the objects of the Association and providing rules for its government, as a means of perpetuating the organization and promoting its influence. For certain evident reasons I think it would be better for such a committee to be elected, rather than appointed, should action be taken upon the above suggestion.

While membership in the Association is restricted to regularly appointed surgeons of the road, appointments to the surgical staff are made from those who are recommended by the Board of Censors, which is a permanent board appointed by the legal department of the Company, acting under authority conferred by them, and responsible only to the legal department for any recommendation made by it.

This Board has adopted the rule that every appointee shall be a member of the American Medical Association as a preliminary requisite, and he must retain such membership during the time the appointment continues in force. This rule is made by the Company for the reason that there must be some definite minimum standard of qualifications to serve as a basis for a choice, and as it is a manifest impossibility for the Censors to know every appointee personally this rule seemed to be the most rational and feasible, as such membership affords presumptive evidence of qualification, and it is certainly no hardship to comply with the requirement.

It can readily be appreciated that an appointment based upon such membership merely presumes the fitness of the appointee, and that thereafter it rests with the appointee to show the character of the qualifications he possesses; and the prime reason why the officials of the Company are in favor of the Association is, that it gives each member in attendance the opportunity to show his fitness, and, at the same

time, to extend his acquaintance with the other members.

It is right that the Company should know the character and ability of the men upon whom it must depend in trying emergencies, and it should be the aim of those who receive appointments to attend these meetings and afford them the opportunity, but I regret to say that an examination of the records of attendance at the last three meetings would indicate that less than one-half the membership have been present, and of those who were in attendance the registry shows practically the same names at each of the three meetings, so that while each meeting has been well attended, active participation has been confined to about one-half the membership, while the others have, to all appearance, ignored both the Association and its meetings.

That the restricted attendance is due to a lack of interest on the part of the non-attending members is evidenced by the fact that the meetings have been held at different points on the line of the road, and consideration has always been given to the question of its accessibility, and each meeting has been held at a point that was within easy reach of a portion of the non-attending members, so that it would appear that attendance at some one of these meetings could have been arranged without any great personal sacrifice, and absence must be accepted as a lack of personal interest, not only in the Association, but in railway surgery.

It is well understood that circumstances may arise which would prevent any of us from attending any certain meeting, but one could hardly conceive that imperative obstacles would interpose themselves to attendance upon a series of meetings. There has been discussion of the ways in which these apathetic members may be impressed with the fact that the responsi-

bilities they have assumed include their attendance upon some of the Association meetings. One proposition made was to take summary action and drop all from the register who have failed to attend any of the three last meetings, but, as it may have been a misconception as to the wishes of the Company on the part of some, rather than a lack of interest, it would appear that a better way of dealing with the matter would be to extend a general notice to the effect that any member who did not attend either the 1911 or the 1912 meeting, and who does not attend the meeting in 1913, shall be considered to have resigned his membership voluntarily and with it his appointment. Such an arrangement would prevent misunderstanding and would make severance of the relationship a voluntary act. If this were done it would be consistent to establish the rule that neglect to attend three consecutive meetings in the future would be considered in the same way.

Another suggestion in reference to this subject, is, that provision be made for two classes of members, *active* and *associate,* and this plan seems to have its advantages and disadvantages, and the matter would require discussion and consideration to determine its feasibility. In case steps are taken for the adoption of a constitution and by-laws, as before suggested, I would urge that some plan be devised to insure a more active interest among the members who are at present apathetic, for I regard it as our duty and privilege to so direct our efforts as to make this Association active and progressive, and to make it a place among the railway associations of the country that will compare with the enviable position that the "Soo" has made among American railways.

While it is in a way unusual to discuss financial matters at a purely scientific meeting, I shall call your attention to one phase, under the caption of annual

dues. The present dues are inadequate to meet the expenses of our meetings and for the publication of the Transactions; and, if we avoid incurring indebtedness, one of two things must be done: increase the annual dues or reduce the expenses.

The only way of reducing expense would be to discontinue the publication of the Transactions; and this would appear to be unwise, as it would be retrogression and would stand in striking contrast to our progress in other respects, which has been steadily forward.

I would urge the Association to consider this matter at the business meeting so that, should a committee be elected to frame by-laws, they may know the sentiments of the Association regarding it.

These matters are important to the Association and should be given consideration, and prompt action should be taken if there is to be a permanent organization effected in the near future, which, I feel personally, is greatly to be desired.

In conclusion, I ask the members who have taken an active interest in the past to continue to do so and to stimulate the apathetic members of their acquaintance to attend future meetings and see if their interest may not be lighted also to an extent that will make them active participants in our work.

Continued interest and activity, together with combined effort on the part of those who have actively engaged in the work of the Association in the past, cannot fail to give us an enviable place among the foremost organizations of this character if, in fact, the distinction is not already ours.

TREATMENT OF FRACTURES OF THE PATELLA

STEPHEN E. GAVIN, M. D.

FOND DU LAC, WISCONSIN

In the preparation of this paper there has been no attempt made to add anything new or original to our present knowledge of the subject, but, in a very brief way, I have attempted to outline what I believe to be the best method to be used in the treatment of fractures of this bone.

I have considered it purely from an operative standpoint, because I believe that practically all fractures of the patella should be treated by the operative method in preference to any other, for the two essential reasons that the functional result is much better, and the duration of disability is so greatly decreased. This preference, of course, is based on the assumption that the case is under the care of one who is certain of his aseptic technic and in proper surroundings. Under no circumstances should the knee-joint be opened except under the strictest aseptic precautions and by one who is thoroughly familiar and experienced with his technic.

These conditions being provided, the question of time of operation is of next importance. We should always wait ten days before opening the joint, in order to allow the traumatized serous surfaces to regain their normal resistance. In fact, I believe the resistance to infection is much increased by the reaction of the serous surfaces to the effects of the traumatism,

so that a joint opened early is much more liable to become infected than one opened late, and, as practically the entire result depends upon the absence of infection, we should not permit any hurry in opening the joint.

The treatment prior to operation consists simply of keeping the limb in extension with a posterior splint, slightly elevated, and a light Buck's extension. Dr. J. B. Murphy injects the joint early with a 2 per cent solution of formalin in glycerin, causing an inflammatory reaction which he believes increases the resistance of the endothelial lining. I believe this to be an excellent procedure, but have not resorted to it in the few cases of patella fracture that I have encountered.

The operative procedure itself consists of opening the joint, making the skin-incision curved, with the convexity upward, at just about the normal upper border of the patella. This is reflected down, the deep fascia incised over the site of the fracture, and the joint opened. Even after a delay of ten days there will probably be considerable effusion in the joint and considerable clotted blood, especially between the fragments. As the fragments are exposed the most important reason for the non-union, or poor union, of these fractures, when treated by the non-operative method, is seen in the condition of the fibrous capsule and periosteum, which has been torn at a different level than the fracture, thus permitting the longer end to drop down like a curtain between the fragments, absolutely preventing approximation of bony surfaces.

This condition existed in the five cases I have encountered. This tissue is drawn up and the loose clots between the fragments removed and the uniting of the fracture proceeded with. Usually the surfaces of the fragments are softened and covered with granulation-tissue. As this is an important stage in the re-

generation of bone, it is not necessary to disturb it. The fragments are united either by wiring or by the use of absorbable material to unite the capsule and periosteum.

I believe the results are uniformly good regardless of the material used, and as in some fractures the lower fragment is so small and difficult to manage in the placing of a wire, and the suturing of the capsule is so simple, I have come to believe that the use of absorbable material in this manner is preferable.

I presume we all have the privilege of changing our opinions. Formerly, I believed that I should always use bronze-aluminum wire in these cases. But I encountered a case of fracture of the patella with the lower fragment so small that while my first impulse was to drill, it was so difficult to manage and hold up so that a drill could be got through it that I sutured the capsule, and in subsequent cases where this method was followed the results have been uniformly good.

Cotton believes that the wire through the patella is more prone to break and produce a poor result than are the absorbable sutures through the capsule and periosteum.

In five cases I have wired three and used chromic catgut and sutured the capsule in two with uniformly good results, and have not found it necessary to remove the wire in any of the cases that were wired. There are unquestionably some cases of comminuted fractures of the patella in which wiring is absolutely essential.

The sutures of the soft parts should not take in too much tissue, as anything that shortens the lateral ligaments or other structures of the joint retards restoration of function and may limit joint-action permanently.

After suturing the capsule the wound is closed without drainage. An antiseptic gauze dressing is applied over the field of operation, preferably using carbolized gauze. This is for the purpose of keeping whatever secretion may form and be discharged into the dressing in a sterile condition. This is covered with a light plaster dressing and a light Buck's extension applied for three weeks. The patient is then allowed to be up with a light removable posterior plaster splint.

Passive motion and massage are used, and the patient, within a week more, is allowed to walk with a cane. Thickening of the capsule and shortening of the muscles from disuse are prevented, to a large extent, by careful early mobilization and exercise, and I believe this early attempt to get the patient about is justifiable in practically every case.

DISCUSSION

DR. ALBERT J. PULLEN (North Fond du Lac, Wis.): Perhaps in no branch of surgery do the efforts, experiments and investigation show any more marked results than that directed toward the saving of bony tissue.

Clinical results show that bone can be united, tendons and muscles spliced, nerves brought together, and blood-vessels anastomosed by ingenious methods, thus restoring all these parts to useful activity.

My friend, Dr. Gavin, in his excellent paper, has told you today that he believes practically all fractures of the patella should be treated by the operative method in preference to any other, and gives you his reasons. The experience of the past few years has led me to believe that most surgeons are too active in treating these fractures by operative intervention. Whether a given case should be treated by operation or not, should be carefully weighed. A closed fracture of the patella does not in itself endanger life. It may be treated by the conservative method without added risk. If properly treated, the result will often be satisfactory as far as the functional usefulness of the knee is concerned.

The operative method consumes less time in convalescence, and an excellent result is achieved; but operation exposes to the danger of sepsis. If sepsis results, bad conditions are imminent,—a stiff knee, amputation of the thigh, and possibly death from septic infection. Whether operation should be done or not, therefore, depends upon the degree of safety within which it can be performed. It is the surest method of securing perfect apposition and bony union.

In either case the indications to be met are the limitation and removal of the effusion, the reduction of the fragments, the maintenance of the reduction until union is satisfactory, and the restoration of the functions of the joint to their normal condition.

Operative intervention in recent transverse fractures of the patella should be decided upon only under most rigid aseptic conditions.

The acute symptoms, as the essayist has told you, should be allowed to subside before operation. The tissues require time to recover from the acute trauma. The operative treatment should be confined to healthy individuals under 65 years of age. The patient should be informed as to the probable outcome by the two methods of treatment. The danger to life and limb should be fairly stated. In open fractures, in re-fractures, and in cases of impaired function from long fibrous union or from adhesions from the patella or from badly united patellæ mechanically impeding the movement of the joint operation is always indicated.

I quite agree with the doctor's aseptic technic in this important operation, that the joint and the fractured bones should be thoroughly exposed by a transverse or longitudinal incision. All clots should be thoroughly washed or sponged out. Any loose small fragments of bone should be removed. In almost all cases a rather dense fascia will be found overlapping the broken surface of the two fragments, especially is this seen in a transverse fracture. These bits of overlapping tissue or curtains should be retracted and removed or utilized in suturing the fragments.

Briefly, I shall call your attention to the non-operative treatment of fracture of the patella:

The fragments are movable and usually widely separated. The separation may be to the extent of an inch or even more. Separation is due in part to the retraction of the quadriceps and the tension of the fascia lata and, in part, to the distension of the joint by blood and exudate.

Crepitus is detected if the upper fragment can be pushed down until it touches the lower piece, but if swelling is great or if fibrous tissue is interposed between the bones, it can not be elicited. I do not consider it necessary to obtain crepitus in order to make the diagnosis; the condition is obvious without this sign. The anterior fibroperiosteal layer is torn, and the tear does not correspond exactly with the line of fracture. A portion of this torn layer may drop between the fragments and prevent union.

If the swelling be so great in a transverse fracture of the patella as to prevent approximation of fragments, reduce it by bandaging for a day or two, by using ice-bags, or by aspirating the joint. As a rule, the blood does not coagulate for several days. When the swelling diminishes, bring the fragments into apposition, pull them together by adhesive plaster, and put on a well-padded posterior splint. Carry a piece of adhesive plaster over the upper end of the upper fragment, draw the bone down, and fasten the plaster to the splint behind and below the level of the joint. Carry another piece of plaster over the lower end of the fragment, draw the bones up, and fasten the plaster to the splint behind and above the joint. Carry a third piece over the junction of the fragments to prevent tilting. A bandage holds the splint in place and may be carried around the knee by a figure-of-eight bandage.

Remove and reapply the dressing every few days, as it inevitably comes loose. At each removal massage the parts. At the end of three weeks, I remove the splint permanently and apply a plaster-of-Paris dressing from just above the ankle to the middle of the thigh, and get the patient about on crutches.

I shall refer to a series of 47 cases of fracture of the patella treated at the Massachusetts General Hospital, occurring between the ages of 11 and 65. Four were over 50; 13 were under 25; 29 were between 25 and 45; 1 was 47, practically a young adult series. Of this series of 47 cases, 10 were treated by operation and the remainder by the expectant method. These cases are not mentioned in this connection to compare methods of treatment, but to determine the condition of the knee a long time after the injury. As a matter of fact, there appeared no greater freedom from the symptoms complained of among the cases operated upon than among those unoperated.

Dr. Rowland Gilmore (Bemidji, Minn.): I have had a few cases of fracture of the patella, have taken care of them both ways, and am a strong advocate of the open method. However, I do not believe it is necessary to wait ten days before open-

ing the joint. Unless there have been great traumatism and extensive damage and contusion to the soft parts at the time of the accident, I cannot believe it is necessary to wait that length of time. On the other hand, I do believe it is bad practice to open the joint immediately. With elevation of the limb and gentle massage, in four or five or six days we will usually get the tissues in condition for operation. In the matter of suture material Dr. Gavin gives us wide latitude of choice. He is more liberal than I would be, for I think it *does* make a difference what suture material we use. Personally, I have not had good results with silver wire. Sometimes it is broken, and sometimes it cuts through the bone. The inner side of the patella is more dense and will resist, but who wants to pass a wire through that section? I do not. I very much prefer to lift the curtain in between the fragments of the bone and bring them together with catgut. We cannot always depend on catgut; however, I do not look forward to such material damage from infection as that set forth by Dr. Pullen in his discussion. We have all taken care of cases of septic synovitis, and I do not believe the surgeon is going to have to make amputation at the hip in these cases. The chance of suppuration from catgut is small, and while there is, I admit, a chance, in comparing catgut with other suture material used in suturing fractured patella, I cannot but feel it is very much the best thing to use.

Dr. John Rishmiller (Minneapolis, Minn.): Fracture of the patella is an exceedingly vital matter, both as far as the patient and the Claim Department of the Company are concerned. As has been remarked by the essayist and the members who have thus far discussed the paper, one ought not be in a hurry to open the knee-joint, for in doing so he assumes a grave responsibility. If able to secure good union without suppuration, one restores to the patient, as a rule, a satisfactory functional extremity and in consequence saves the Company much expense; therefore, the most important element in operating on fractured patella is exaggerated technic of asepsis, and rubber gloves should always be worn. After the incision has been made the skin should be clamped off, with sterile towels or gauze, from the wound, as through the operative manipulation epithelia are rubbed into the wound, thus favoring infection. As is well known, osseous tissue cannot take care of septic material as well as the peritoneum, and if perchance one should infect the peritoneal cavity, it will, in a large measure, take care of the invading enemy, but if the same amount of septic material is accidentally carried into the knee-joint, suppuration will follow, and a stiff joint result.

There is great latitude as to the best time to operate in these cases, and if I had a patient with a fractured patella, or if I were compelled to undergo an operation for fracture of the patella, I should not wait ten days. Undoubtedly, the best time to operate is after the tissues have coffer-dammed themselves, say twenty-four hours after the extravasations have ceased to pass into the injured knee-joint. Five or six days after the injury, if there has not been too extensive bruising of the tissues, is, in my opinion, about the best time to operate. Then, we must always consider whether the fracture was produced by falling on the knee, causing a great deal of abrasion and extensive contusion, or by muscular action. In case the patella has been fractured by muscular action, we can operate sooner and with a better prognosis than in the case where the fracture was caused by direct violence, as in these latter cases the tissues are more devitalized and less liable to resist infection.

I remember a case of stellate fracture in which I waited seven days before operating, with the result that I experienced considerable difficulty in getting the fragments together on account of the more or less permanent muscular contraction. In consequence, a great deal of pulling and bruising has to be done, when one is liable to get the hands into the wound just once too often.

With reference to suture material: I am in favor of using heavy silver or aluminum-bronze wire. Dr. Gavin stated that in one case he could not use wire, and I believe it would not have been advisable to drill a hole in the small fragment and attempt to pass a wire through it. The periosteum over the patella and fascia lata at the side should be brought together by twenty-day chromicized catgut. If one is sure of his technic, there is no contra-indication for using inabsorbable material for bringing the fragments of the patella in direct apposition, but if one has no confidence in his aseptic ability then, of course, absorbable material is in his favor. Whenever one's technic is so perfect as to get no suppuration then one can use inabsorbable buried suture material.

My reason for using wire is this: As we know, we never can absolutely depend on chromicized catgut. "Twenty-day" catgut may last thirty or it may last only ten days; therefore, if the catgut absorbs too early, diastasis of the fragments may result. But when one sutures the fragments with silver or aluminum wire, in addition to suturing the periosteum and fascia lata with catgut, he knows the fragments will then stay in apposition. In the case of a stellate fracture we cannot very well hold the fragments in accurate apposition without suturing

directly through the fragments. Then, again, I like to use wire to lessen the likelihood of refracture after the patient commences to walk.

So far as danger of the patella adhering to the lower end of the femur is concerned, I do not believe we need to worry, for, in my experience, no untoward effects have resulted. All cases of fracture of the patella ought to be put in plaster-of-Paris casts to insure firm immobilization. We all know that the quieter a fractured bone is kept, the quicker will union take place, and it is a notorious fact that one of the bones which gives us greatest trouble from non-union is the humerus, simply because we cannot keep it quiet.

DR. CHARLES A. STEWART (Duluth, Minn.): In bone-surgery of any description it has always appeared to me that the all-important feature is absolute asepsis. If you do not do your work in an absolutely aseptic way, you are very liable to have some degree of failure. And in such operations I think it is well not only to wear gloves, but even then not to touch the wound with one's fingers; and that all manipulation in drawing the bones together, suturing,—everything of that kind,—be done by the use of instruments.

The time for operating, as Dr. Rishmiller has justly said, depends largely upon the character of the traumatism which produces the fracture. If it is caused by muscular action, intervention can be made at a much earlier time; if it is caused by a blow or by bruising, in which there is a decided traumatism of the tissues tending to devitalize them, time must be allowed for a certain amount of repair in order to avoid adding to the already devitalized condition.

In the choice of material for sutures, when one depends upon catgut that is said to remain in the tissues 10, 20, 30, or 40 days, he is depending upon a fallacy. No manufacturer of catgut can tell to any certainty the length of time it will remain intact. Personally, when using catgut I employ that which is manufactured under the auspices of the Ramsey County Medical Society, for they say that their formalinized catgut will last for weeks in the tissues. It does not, however, always do that. On different occasions I have been disappointed by having it give way too soon. But, as a rule, it is quite reliable, and it does not matter in this fracture whether it lasts 20, 40, or 100 days. But if you use a suture material which eventually becomes absorbed I think it is better for it to last 60 to 100 days, rather than only 20 or 30.

DR. GAVIN (closing the discussion): I naturally expected more or less critcism of several of the points brought out in the

paper, particularly as to the time of operation and also as to the question of operative treatment in all cases.

As to the matter of time of operation: It would seem that there has been a question in the minds of all the members who have discussed the paper, as there was in my mind for a long time, but I finally decided that ten days was the proper time to wait. Dr. Gilmore has stated that it is in his opinion a decided waste of time to wait ten days before operating, and that he would operate in six. If the extra four days is going to be any advantage in preventing infection, the four days' loss of time is not going to be very material to the patient.

The coffer-damming of the tissues which occurs in all cases of traumatic synovitis is also a condition which is questionable so far as length of time for its production is concerned. If it is coffer-dammed in six days the coffer-damming would remain in ten days, and it might not be coffer-dammed in six days. Therefore the four days' leeway is extremely important. I believe the majority of men doing bone surgery are inclined to wait that length of time, although in consulting authorities on this subject recently I found that some operate as early as three days.

The old bugaboos which Dr. Pullen mentioned,—a stiff knee, amputation of the thigh, and possibly death,—are the same stereotyped objections which have been handed down to us for generations. The point I made, that no man not properly qualified should touch a fractured patella so far as open treatment is concerned, is possibly the important one. A man not thoroughly familiar with asepsis, doing all sorts of surgical work and knowing when he is septic, should not be allowed to touch a fracture of that kind; the fact that a man has read what asepsis is and has perhaps done a little emergency surgery, does not qualify him to handle these cases. If fracture of the patella occurs in a section where a man of sufficient experience is not available, a leeway of ten days to allow some one properly qualified to be got on the scene, or to get the patient to a hospital, where that treatment can be given, is not too great.

Another important factor to be considered in connection with operative treatment in a case of fracture of the patella, is the length of time required to get a man back to work. In a patellar fracture treated by the non-operative method, it is a matter of months and probably a year before a laboring man is able to resume his work. As Dr. Rishmiller states, to us surgeons doing work for a railway company, the outcome of whatever method of treatment we may employ is mighty important. If we can, by adopting the operative treatment in these cases, get

our patient out in two to three months at the outside with a perfectly normal knee, in contradistinction to a knee disabling the patient for six to eight months, and then getting him out with a defective knee that will never allow him to brake or run an engine, I think we should always choose the operative method of treatment.

TRAUMATIC SYNOVITIS

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When I selected traumatic synovitis as the subject for a paper, I realized that my experience in these cases would be greatly overshadowed by that of many present, but believed that among the rank and file of the profession the end-results in these cases are not always gratifying. I had in mind more particularly the synovitis following injury to the knee- and ankle-joints.

Synovitis of the knee-joint is much the more common, as the synovial membrane is thrown into folds and reflected over ligaments, which exposes it more to injury by pinching; and also it surrounds the outside of the articulation more superficially and is more open to injury from blows. Injuries to the ankle-joint are more often strains or tears of ligaments, with perhaps some detachment of small particles of bone. A synovitis here is most often complicated by other injuries, but the treatment outlined would suit, in almost all cases, the conditions present.

In my experience as interne in a railway hospital, nine years ago, I noticed that among the men who came for treatment and who remained the longest, were the greatest care, and did the most complaining and threatening to sue the company, were men who had received an injury to the knee- or ankle-joint, either alone or in conjunction with a fracture of the leg.

In case there had been a fracture, locomotion was delayed by the painful joint, and, often, the slow complete recovery was a source of irritation to the patient and worry to the surgeons; and even in cases where there had been a simple synovitis from twisting or wrenching it was almost impossible to get the patient well without his entertaining grave suspicions that the surgeons were not capable and that the railway right-of-way had been improperly maintained at the point where he had received his injury.

These cases are very disabling and slow to recover. They are frequent, and often cause friction between the employer and employe. A sound pair of legs is necessary to a railway man in the performance of his duties, and equally as important in saving him from danger. It would seem therefore that the proper care of traumatic synovitis from the beginning, and a forced vacation until the injured joint was absolutely well, were of considerable importance to the railway surgeon, as well as to the railway company, and certainly of more importance than the injury would at first appear.

The injury may be immediately disabling or not very noticeable for twenty-four hours, is very painful, and is apt to cripple a man for railway service for several months. He may think he is able to go to work after a couple of weeks, and may insist on it, thinking that the joint will improve with use; but here is where he makes his mistake, and it is hard to impress upon an otherwise strong and healthy individual that use will not improve an inflamed synovial membrane, whether it be in the joint, in a bursa near the joint, or in the sheaths of tendons extending along the joint. After an apparent recovery, then an attempt is made to work, over-use, or perhaps a slight twisting that ordinarily would be of no moment, causes the inflammation to increase, and he is back in

the hospital with the earnest belief that he is crippled for life and that he is entitled to heavy damages.

These cases do occur, and will continue to occur. What is the injury? What is the proper treatment? And when should the injured person be declared fit for duty?

It is not necessary here to go into the details of joint anatomy, but it might be well to give the structure of a synovial membrane. Synovial membranes are serous, consisting of loose connective tissue, containing fat, vessels, and nerves, and lined with a single layer of flat endothelial cells. Joint cavities, and bursæ connecting with joints, contain a small amount of fluid, which is a secretion of the synovial membrane. It is alkaline, saline, viscid, yellowish-white or slightly red, and somewhat cloudy. This serous membrane lines the interior of the joint sac or capsule, and is reflected onto the bone, to which it is attached down to the articulating cartilage.

A traumatic synovitis would mean an inflammation of this serous membrane, set up by a traumatism. This inflammation would bring on swelling or edema of the serous membrane, and cause a pouring out of more fluid into the joint. This is confined within the capsule and has no ready means of escape. It therefore has a tendency to add to the congestion, and is one of the sources of excruciating pain experienced by the patient. The natural method of removal of excess of fluids from within a joint is through stomata in the endothelial lining of the serous membrane, but this is blocked in synovitis by the inflammation.

Treatment.—In treating these cases we have to deal with an inflamed and congested serous membrane, pressed against its enveloping fibrous capsule by fluids from within. It would seem that the first thing to do in a case of this kind would be to relieve the pressure by aspirating the joint. This will remove the pressure

from within at once, and greatly relieve the pain, and, what is of more importance still in the eventual outcome of the case, prevent the stretching of the capsule and general loosening of the joint as a whole. It further has been my experience that it shortens the period of convalescence. It is a very simple procedure, usually done under local anesthesia, and need cause no bad results if proper cleanliness is maintained. I believe every case of acute traumatic synovitis where there is a fully distended joint-capsule should be aspirated and the fluid not quite all drawn off. It aids in the diagnosis of the case as well, and will sometimes bring forth surprises in the nature of the fluid which the joint contains, as happened to me only a few weeks ago. A man of 65 was thrown from a buggy and injured his knee. He came to me three days after the accident with a very painful and distended joint. I aspirated it and drew off about 5 oz. of almost pure blood.

These cases are not rare, and while the blood may be entirely absorbed and removed, there is nothing certain that they will not become infected, or that the blood will not clot and organize over torn surfaces and form adhesions within the joint, before the damaged synovial membrane has had time to remove it by absorption.

Acute inflammation and congestion are best relieved by rest and the application of cold. The next step in the treatment would therefore be to put the patient to bed with a light posterior splint, and an ice-bag over the joint, and pillows or sand-bags so arranged as to support the leg and prevent motion. After the joint has been aspirated, compression is an advantage. The weight of a large ice-bag mushroomed over the joint helps to serve this purpose.

In the large majority of cases the inflammation will now rapidly subside, the pain disappear, and any

fluid that has accumulated within the joint be absorbed. The patient will then demand that he be allowed to get up, and, as the pain and swelling are gone, use the leg; but to permit the latter would be a mistake. The knee should still be kept at rest by bandages, and the ankle in a cast. Adhesive strips should be placed across the knee to limit the motion of the patella, and pads of cotton wool in gauze arranged about the natural depressions of the joint so as to exert pressure when a bandage is placed over them. The patient can then be up on crutches without any probability of injuring the knee-joint. I put the ankle in a cast because I believe that it is almost impossible to get a traumatic synovitis of that joint without tearing of ligaments.

These dressings should not be discarded until all pain and swelling have disappeared, and then when removed, elastic supports should be worn another month, or until all sense of weakness or insecurity of the joint shall have disappeared. The muscles above and below the joint should be massaged daily, and while the patient is confined in bed the leg should be kept elevated to favor the circulation. When the supports are discontinued the joint should not be violently manipulated, but use attained gradually.

By following this course of treatment I believe that practically all cases of simple traumatic synovitis will be permanently cured, and that in the shortest possible time.

There are cases that will require more than one aspiration, but this procedure should be carried out as often as the joint refills. Unless there be some systemic reason for it, a very severe inflammation will not require more than two or three aspirations.

There should be very little or no fever with a simple traumatic synovitis. If this should occur and the joint symptoms increase, a complication is most prob-

able. A hematogenous pus-infection of a joint is rare. One should suspect first a gonorrheal arthritis and inquire as to previous infection, or, if the injury has followed some infectious disease, the infection may localize in the joint. Again, according to authorities, there is a direct relationship between trauma and tuberculosis of joints.

Acute traumatic synovitis becomes chronic in many cases. This may be due to internal derangement in the joint, as displaced cartilages, or infolded torn capsule, adhesions, etc. In these cases a chronic synovitis would supervene and continue to bother until operative measures removed the cause. Inflammation continuing without these internal derangements is almost always due to inadequate treatment. A doctor friend of mine suffered from this condition for three years. He injured his knee while lifting and suffered a sharp attack of inflammation. He suffered from intermittent hydrops and periods of partial disability for three years, and now, eight or ten years after the injury, which he at first thought a simple one, he has a creaky joint that acts as a very fair barometer.

To sum up, treatment of the knee consists in—

First, relieving pain and tension in the sac by partial removal of fluid.

Second, controlling the inflammation by complete rest in bed and application of ice-bag until the inflammation commences to subside, which usually occurs in from three to four days.

Third, in massage of muscles above and below joint to prevent atrophy, which is a serious complication and greatly hinders complete recovery.

Fourth, maintenance of compression over the natural depressions of the joint to keep it from refilling and to hasten absorption.

Fifth, fixation until all swelling and pain have disappeared.

Sixth, elastic supports after motion is permitted.

In simple sprains of the ankle it is rare that aspiration is necessary, but proper fixation by adhesive strips is essential; and in severe cases with tears of ligaments or detached bone-fragments, a cast should be put on after swelling has subsided and kept on at least three weeks, when massage and graduated motion are commenced.

I do not claim any originality in this method of caring for these cases, but when I occasionally see the results of inadequate methods I cannot help but think that the proper care from the beginning and maintenance of proper support until all inflammation has subsided, is of great importance to the railway company, as well as to the patient.

DISCUSSION

Dr. H. Jefferson O'Brien (Superior, Wis.): When we exclude all constitutional diseases that cause synovitis and consider merely the subject of this paper, the traumatic form, the question of prognosis and after-treatment seems to be quite simple. From observations I have been able to make and from recent reading of the literature, Dr. Catlin has not left many loop-holes for criticism. However, from a review of the subject and after hearing the paper read, a few thoughts have occurred to me:

First. I would take issue with the essayist on the ready freedom with which he suggests aspiration of joints.

Second. I would accentuate the importance of rest for the parts. In the matter of traumatic synovitis the discussion has seemed to center on the knee-joint, whereas this condition involves other joints as well,—the shoulder, ankle, and wrist. Usually traumatic synovitis is merely one of the symptoms of the injury. But, as has been said in connection with the subject of operative intervention in the case of fractures of the patella, analogous to synovitis, when we remember the responsibility assumed in opening the joint to aspirate it, the

matter of waiting several days before doing this ought, I believe, to be seriously considered. In a case of mere fluctuation induced by the throwing out of a liquid, we should not be in a hurry to aspirate, for, if we do this without first giving absolute rest, allowing sufficient length of time for compression to determine whether or not this liquid is going to be absorbed, we are, I think, treading on dangerous ground. If, however, after mechanical measures, such as proper bandaging, rest, etc., have been employed, there are systemic manifestations showing that the fluid is not absorbed, then it is time to aspirate. But when one first sees the case, one, two, or three days after the sac has filled, and immediately aspirate it, if we are actually sure of absolute asepsis, which we probably never are, it is very well. This is one point in the paper that should, I believe, receive earnest and serious consideration. If the condition is one of simple traumatic synovitis, these cases seldom give any great trouble. But the important point is to prevent them from becoming chronic, for there is where disability begins.

In case we have trauma of the synovial membrane that is sufficiently severe to tend to become chronic, an element of importance is the position of the limb after it is shown that there is partial disability at least. My observation is that the knee should be slightly flexed if there is going to be any stiffening and facilitate the activity of the patient, especially in railway cases the maximum utility of the leg.

DR. CYRUS N. CALLENDER (Fargo, N. D.): In connection with this paper, as well as that on fracture of the patella and its discussion, it occurs to me that we should be uneasy at the evident tendency to too radical treatment or too much operative intervention. In this connection, let us think of the structure of this tissue the essayist has spoken of and analogous structures, such as the synovial membrane of the joint, the bursæ, tendon-sheaths, pleura, peritoneum, and the similar tissues associated with the spinal membranes, canals and meninges, their analogous development and function. Inflammation set up in these, either by trauma or infection, must be considered in the light of their histology. This suggests that, if we are going to do thus and so with traumatic synovitis or bursitis, shall we not have to do the same with all other such effusions in the analogous tissues? This emphasizes the danger in all such intervention as brought out by the gentlemen who have discussed this paper, i. e., infection; and the point in which we are most concerned, is whether we have not added more trouble than we have been able to relieve.

In the light of what I have said, I am impressed that we should carefully consider this proposition of traumatic synovitis as well as the fractures named; as well be careful to exclude all possible associated traumatic disturbances which may be around these joints, and have been brought out in the paper, these so-called sprain-fractures. When we have satisfied ourselves that there is no injury separating the bony tissue, and that we have a pure traumatic synovitis, we should remember results obtained by the conservative handling of such cases and should feel confident that with rest and traction and later passive motion, as has been here outlined, independent of open incision or drainage, the ultimate results will be all that could be desired.

DR. FRANK S. WILEY (Fond du Lac, Wis.): The subject of traumatic synovitis has been so thoroughly discussed that there is little left to be said, except as regards prophylaxis or prevention of synovitis following traumatism. The important part is to guard against a synovitis, and the only way that we can do this is by immobolizing every injured joint as far as possible, and keeping them immobilized until all danger from inflammatory process has subsided. We oftentimes pay too little attention to a simple traumatic injury of the knee or any other joint. With proper care at the start, it matters not particularly what method is employed, these conditions can be avoided. Usually, in the case of the knee-joint I like to take adhesive strips and strap the joint carefully, not encircling the limb so as to obstruct the circulation, but coming around two-thirds of the distance and fixing it firmly with a posterior splint, the limb in slight flexion. And injuries of all joints, I believe, should be dressed between flexion and extension, especially in the event of possibility of getting an ankylosis. If one has ankylosis of the knee-joint, and this midway between flexion and extension, he can walk very readily and have a reasonably useful limb.

In regard to aspirating the knee-joint: The same general surgical principles, referred to by Dr. Gavin in connection with opening the joint for suturing the patella, are applicable in aspirating the joint. The same aseptic precautions should be as carefully taken in aspirating the joint as if one were going to open it for the purpose of suturing, for, if infectious material is carried into the joint, we have the same dangerous results following. I would not aspirate a joint until after it had been strapped and immobilized for some little time; then if there is no attempt at absorption I believe not only that the surgeon is justified in aspirating the knee-joint, but

that the results obtained by this procedure are better than can be secured by any other method of treatment. Another important element of the treatment, especially of the knee, is the employment of extension and passive motion of the joint and keeping the surfaces separated for the time being.

DR. STEPHEN E. GAVIN (Fond du Lac, Wis.): The last statement Dr. Wiley made is very important, that is as to extension of the joint, whether it be the ankle, knee, or any other. If you can put extension on the limb and separate the surfaces, it is a most important point in the treatment of synovitis. If you put on Buck's extension with fifteen or twenty pounds weight, the pain will disappear like magic, and the separation of the surfaces of the joint will minimize adhesions and the danger of a stiff joint.

DR. LOUIS A. NIPPERT (Minneapolis, Minn.): The prevention of synovitis, as several have mentioned, is of the greatest importance. We cannot, of course, keep the patient from being injured, but we should very carefully take his history. We all know that a joint once affected is much more liable to have the trouble start up again. In the case of a person with rheumatism, injury of the joint may precipitate an attack of articular rheumatism, or a joint previously affected may continue to be useless for a long time on account of the rheumatic diathesis and general condition of the patient. Tuberculosis also is a factor in prolonging an attack of synovitis almost indefinitely. Bright's disease is another condition affecting the constitution in such a way that a slight injury will prolong the case for a long time. Gonorrhea is notorious, not only in causing, but in prolonging, synovitis, and these cases sometimes figure in the courts, the claimant maintaining that synovitis was caused by injury.

DR. NICHOLAS J. SHIELDS (Lidgerwood, N. D.): I wish to emphasize the importance of treating every case of synovitis the same as a fracture, with absolute immobilization, either by plaster cast or splints, and with extension.

In regard to aspirating: I believe the subject as presented by Dr. Catlin is intended to cover all the joints, and I am sure it would be inadvisable to attempt to aspirate a great many joints of the body.

I believe in being very conservative about aspiration, especially early aspiration. Where secondary infection takes place, aspiration is indicated for diagnosis, but is hardly sufficient for curative purposes. There the proper thing to do is to establish

free drainage of the joint; but in the early treatment I would emphasize that the best results always come from immobilization, and treating the case the same as for fracture.

DR. CATLIN (closing the discussion): The main objection to the course of treatment outlined seems to be early aspiration. Now, if that is done under complete asepsis,—and there is no reason why it should not be so carried out,—I cannot see why it should be at all dangerous to the patient. It has been my experience that those of my cases that I have aspirated have recovered quicker than those not aspirated.

EYE INJURIES AND HOW THE ONSET OF THEIR DANGEROUS COMPLICATIONS MAY BE RECOGNIZED

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This paper will be limited to the discussion of injuries of the eyeball and particularly those injuries which you as railroad surgeons would be expected to treat.

THE EXAMINATION AND DIAGNOSIS

This is where the specialist has the principal advantage over the general surgeon. He has a room which can be darkened, with a movable wall-light, a condensing lens to concentrate that light on the cornea, and a loupe or magnifying glass to see small lacerations and foreign bodies. You can make your office dark enough by pulling down the shades, providing they are dark colored. A round, frosted, electric bulb on a movable bracket, attached to the wall four feet from the floor can be installed at small expense. This you will also find useful for examining nose, throat, and ears, with a head-mirror. A 13-diopter condensing lens will cost about fifty cents and a loupe about $3.00. Resurrect your old ophthalmoscope, and the specialist's principal advantage is yours.

The examination should be systematic. Do not attempt to examine an injured eye until you first have the history of the injury. A good history will often tell you whether an injury is penetrating or non-penetrating, whether the coats of the eye are apt to be rup-

tured or the zonula torn. If a small foreign body is blown into the eye you would not expect to find a penetrating wound. If a small foreign body struck the eye while hammering or cutting steel or from a blast, you would look for a penetrating injury. If the eye was struck by some large blunt object, you would look for a contusion, rupture, or dislocation of the lens.

If the eye is irritable put a few drops of four per cent solution of cocain muriate in it before beginning the examination.

Seat your patient with the light about two feet to the side and a little in front of the injured eye; separate the lids and throw the light on the cornea, with the condensing lens. Do not look at the cornea as a whole, but examine every part of it, as you have the patient move the eye slowly. If you suspect a foreign body and do not find it lodged in the cornea or conjunctiva, evert the upper lid, and then have the patient look up while you draw down the lower lid. If a penetrating injury is suspected, test the tension of the eyeball. The eye will be soft if a penetrating wound is present, unless very small. See if the pupil is round. If the wound is through the cornea, there is almost sure to be a prolapse of the iris, which would make the pupil irregular. When the pigment-layer is prolapsed you can see it protruding through the wound.

Wounds through the sclera are not so easy to detect, as the conjunctiva has a very peculiar way of hiding them. I have seen an eyeball with one-fourth of its interior occupied with iron ore from a blast which entered through the sclera in which a penetrating injury was not suspected.

Blood in the anterior chamber would indicate some injury to the iris. This is generally not serious unless the iris is separated at the outer edge from its attachment to the globe, forming another pupil. When this

happens the vision is impaired by dazzling from too much light entering the eye.

After progressing thus far with your examination, if your are unable to make your diagnosis, test the vision. If the vision is normal, the injury is probably not serious, and is probably a contusion or concussion. If the vision is impaired, it would suggest that you have a dislocation of the crystalline lens, a rupture of the choroid, or detachment of the retina. In a forward dislocation of the lens, the iris is back of the lens and cannot be seen, and the pupil is very large, extending from one scleral margin to the other. To diagnose the other dislocations of the lens the pupil should be widely dilated with 1 per cent atropin solution. In a downward dislocation the upper margin of the lens can be seen as a faint crescent. If the zonula (the ligament which holds the lens in position) is torn, either below or on the sides, a movement of the lens can often be detected by having the patient move his head forward and back. Rupture of the choroid may be suspected from the nature of the injury and loss of vision, but should be confirmed with the ophthalmoscope. Detachment of the retina causes blindness in that part of the field of vision corresponding to the detachment.

TREATMENT

A large majority of the eye injuries you will be called upon to treat are from small foreign bodies. If loose, these can be flushed out with boric-acid solution or wiped out with absorbent cotton wet with boric solution. If imbedded in the cornea, the eye must be anesthetized with two or three drops of a 4 per cent solution of cocain then in a good light an effort should be made to remove it with a small amount of cotton twisted rather tightly on a sharp toothpick and moistened with boric solution. If this fails, pick it out carefully with a sharp spud. Do not use an instru-

ment in the eye, unless you know it to be sterile. A good practice is to rub it well with alcohol before and after using, and then do not use it unless by the aid of a good light and loupe or magnifying glass, you can see the object to be removed clearly.

The foreign body can and should be removed without further injury to the cornea. Indiscriminate scraping of the cornea in the vicinity of a foreign body is poor surgery and is generally the result of poor illumination of the field of operation.

After removing the foreign body, flush the eye with boric solution, and if the eye is very irritable, instil a drop of 1 per cent atropin solution and apply a bandage.

We should all remember that Bowman's membrane lies just beneath the epithelial layer of the cornea, that an injury of this membrane will leave a scar, and a scar near the center of the cornea interferes with clear vision.

The most dangerous complication of these injuries from foreign bodies is the hypopyon ulcer, or ulcus serpens, and its early diagnosis is very important. Fortunately, the diagnosis of this dangerous ulcer is easy. There is always the history of getting a foreign body in the eye or receiving an injury which produced an abrasion of the cornea. It is generally located near the center of the cornea. The ulcer in its early stages is small and disc-shaped, with a yellowish-white, brush-like area, extending beyond one of its margins. This yellowish area is caused by the extension of the infection down into the layers of the cornea at an angle, leaving an overhanging ledge, which makes its treatment difficult; for, if treatment is to be effective, it must be applied beneath this ledge and at the progressive margin. The appearance of pus in the lower part of the anterior chamber makes the diagnosis complete.

The seriousness of this complication will probably be best illustrated by giving you the history of a few selected cases. The following has been about an average case in my practice:

J. A., a mine captain, aged 52, came to my office January 22, 1912, complaining that he had got something in his left eye two days previously. A small foreign body was found imbedded in the center of the cornea. This was removed and the eye flushed with boric solution, a drop of 1 per cent atropin solution instilled, a bandage applied, and he was given boric wash with directions to use three times daily.

He returned two days later with a typical hypopyon ulcer in the site of the foreign body injury. The eye was anesthetized with cocain, the ulcer curetted, and cauterized with 95 per cent carbolic acid. The eye was then flushed out with boric solution, silver nitrate solution, 4 grs. to the oz., applied to lids, and the pupil dilated with atropin. He was then sent to a hospital with directions to keep hot fomentations on the eye, 5 grs. of aspirin every three hours, and given a saline cathartic. The same treatment was continued for three days, when the hypopyon (pus in the anterior chamber) disappeared, and the ulcer stopped progressing. The eye required treatment with atropin and dionin for about a month before the ulcer was entirely healed.- On April 10th, some two and one-half months after he got the foreign body in his eye, the vision was 20/40. The vision in this eye before injury was 20/15.

The following case is typical of the more severe cases of hypopyon ulcer: S., a laborer, 29 years old, applied for treatment March 19th, giving a history of having had a foreign body in his left eye two days previously. On examination I could find no foreign body, but he had a small, round, foul ulcer of the cornea just below the line of vision. There was no pus

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in the anterior chamber. He had a suppurative inflammation in both tear-sacs.

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The same treatment was given as in the preceding case with the addition of washing out the tear-sac with boric solution, in an Anel syringe, and injecting a 10 per cent solution of protargol. The following day a progressive, yellowish margin extended upward from the ulcer. This was curetted and again cauterized with carbolic acid. The third day a hypopyon developed in the anterior chamber. In addition to the curetting and cautery, a subconjunctival injection of cyanid of mercury 1:10,000 was given. On the fourth day the actual cautery was used on the progressive margin. On the fifth day the hypopyon extended up partly over the pupil, and the ulcer had grown steadily larger until now it occupied about one-fourth of the cornea. As the base of the ulcer was thin and slightly bulging I made a Sæmisch incision which evacuated the hypopyon. This incision is made by inserting a cataract knife at one margin of the ulcer bringing it out at the opposite side and cutting up through the base of the ulcer. The sixth day the ulcer was still progressive. The whole ulcer was thoroughly cauterized with the actual cautery. The seventh day there was still a small progressive margin on which the actual cautery was again used. This stopped the progress of the ulcer, which healed in about five weeks, leaving a large dense scar over the center of the cornea, which makes the eye useless.

These cases vary widely in severity. I have had cases where the ulcer was not close to the line of vision which yielded promptly to treatment, and vision was but slightly affected. Again, I had a case which I first saw five days after having a foreign body removed from the eye in which the ulcer covered the entire cornea, and the hypopyon filled the anterior chamber.

This ulcer is always serious. If an eye does not get well promptly after removing a foreign body, watch closely for this infection. It always has the appearance I have described.

PENETRATING INJURIES

Penetrating injuries of the eyeball interest the general surgeon principally in regard to the first treatment and the prognosis, as such injuries are generally referred to an oculist. The lids and surrounding parts should be washed with water and a neutral liquid soap, and the eye flushed with boric acid solution and the pupil dilated with atropin. Foreign bodies in the anterior chamber should be removed at once. Fragments of iron or steel which penetrate the vitreous should be removed with a giant magnet as soon as possible.

If there is a prolapse of the iris it should be carefully freed from the edges of the wound, drawn out, and snipped off, so that when it retracts the iris will be free from the wound.

Where the crystalline lens is injured a traumatic cataract will generally develop. If the foreign body is lodged in the lens it can be removed with the cataract.

If the retained foreign body is small and cannot be removed, and the eye has useful vision, it is the common practice not to remove the eye unless a plastic inflammation develops, or the other eye shows signs of irritation or loss of vision. The great danger in retained foreign bodies is sympathetic ophthalmia. This should always be thought of, and the patient fully warned of its gravity. In cases of severe injuries in which the eye is hopelessly destroyed, it should be enucleated at once to save the patient suffering and a prolonged illness.

The most dangerous complications in penetrating

injuries are panophthalmitis and sympathetic ophthalmia.

Panophthalmitis comes on soon after the injury and is the result of an active infection. Its onset is accompanied by pain, chemosis, and swelling of the lids, with rapid and complete loss of vision. Pus can usually be seen in the pupil.

Sympathetic ophthalmia may follow a penetrating injury, but is more apt to occur when there is a retained foreign body. It usually sets in within four to eight weeks after the injury, but may develop many years later, and has been known to occur within ten days of the injury. It is excited by a plastic inflammation in the iris and ciliary body of the injured eye and affects the same tissues when it appears in the good eye.

An attack of sympathetic ophthalmia begins by the injured eye becoming painful and red. This is followed by a weakening of the accommodation in the good eye; in other words it tires the patient to read or do close work, and the eye becomes sensitive to light. Later the vision becomes cloudy, the pupil is small and responds poorly to light, and there is ciliary injection and tenderness.

If the offending eye is not enucleated and the proper treatment instituted by the time it reaches this stage, the inflammation continues until the vision is destroyed.

In conclusion, I wish to emphasize the following points:

1. The importance of oblique illumination in locating and removing foreign bodies lodged in the cornea.

2. The necessity of strict asepsis in even the most trivial injuries to the eye.

3. The advantage in the early recognition and prompt, energetic treatment of the hypopyon ulcer.

4. Your duty to give a patient with a retained foreign body full warning of the danger of sympathetic ophthalmia and to tell him how he may recognize its onset.

DISCUSSION

DR. JOHN STEELE BARNES (Milwaukee, Wis.): The early recognition of complications in eye injuries is certainly an important topic for all railway surgeons, and I will say just a few words which may be of interest and help to you.

In an injury of any nature to the eye that you think you cannot treat yourself and which you are going to refer to the oculist for treatment, be sure and put that eye in such a condition that no extra amount of damage is done by your neglect—in other words, render what might be called the first aid. In the large manufacturing city of Milwaukee we get a great many eye injuries, and I find that physicians are very prone to neglect that thing. Even physicians outside in the state sometimes send in a case just tied up with a dirty handkerchief.

So far as the early recognition of symptoms is concerned I am not going to touch on this phase at all, but the important point is, you can do a great deal in eye injuries with your first-aid treatment, putting the case in such condition that sepsis or infection will not take place because of your neglect.

Perhaps a few points in the way of treatment of eye injuries may be of value to you in a routine way. I believe that every injury to an eye should be looked upon as a possible serious injury and not lightly considered. I have always had a pet theory that in an injury of the eye the first thing to do after immediately and thoroughly cleaning up the wound is to use cold compresses. Whether the cold has any effect in inhibiting infection I do not know. The old classic way was to always use heat, but I have found that invariably my cases do very much better with ice compresses. I always use atropin, and of late years for internal treatment urotropin or hexamethylenamin. This is one of the very valuable drugs that can be used in these cases, because it has been demonstrated that hexamethylenamin may be found in the anterior chamber of the eye. I have found that in cases of wounds that are very liable to be infected, hexamethylenamin in 5-grain or 7-grain doses in one or two glasses of water four times a day, is of great value. Aspirin is another drug I use internally in all cases of eye injuries, because I am sure it assists in relieving the pain that may be present, and it is a question if it does

not also act somewhat systemically on the perhaps latent inflammatory affection.

DR. CHARLES D'A WRIGHT (Minneapolis, Minn.): There are a few things which I think it would be well to speak of. Of late years all practitioners have become so very careful with asepsis that I do not receive an eye injury not very aseptically handled. The practitioners tributary to us at least are doing so.

Regarding the matter of cold applications referred to: For some little time I have practiced this in selected cases, especially if the patient is young and robust, and if there is no neuralgia or pain resulting from the application of the ice-compress, I agree with Dr. Barnes in that; but in older people I change to the hot more quickly. And where we use hot applications I believe in an aseptic hot pack for thirty minutes every three hours. Have it hot. After corneal injuries in which the anterior chamber is open there is no question but that the instillation of 40 to 50 per cent argyrol solution in the anterior chamber does lessen danger of infection. The urotropin I find extremely useful. Stimulants and extra feeding are very useful in old or weak patients.

One other point which seems to me to be very important is the use of a cautery where an ulcer is starting and progressing, where an ulcer does not heal, or where pus is forming in the anterior chamber. A cautery used early in these cases stops a long series of very painful troubles. One of the most simple and easily obtainable cauterants is nitric acid in 30 to 40 per cent solution. But nitric acid is very bad unless it is used just so, because of its spreading qualities. However, if one will employ for the application of this agent an aseptic porous pine-stick, using of the nitric acid solution just what will go into the pointed probe, being very careful that there is no excess, it forms a cautery that is adequate and safe in any place. The cauteries which come with gasoline lamps are very useful. With regard to the Sæmisch incision. It seems to me that the cautery, either actual or nitric acid, gives much better results, if used early enough.

When we make a Sæmisch incision we very, very often get a prolapsed iris. When this occurs it is unwise to do iridectomy until the infection has passed over. Iridectomy opens so many lymph-spaces for infection that I urge delay in such cases.

When optic neuritis presents after cranial injury, a lumbar puncture often relieves the condition and saves the opera-

tion of sub-temporal decompression. These things impress me very much of late, and I bring them to your notice for consideration.

DR. GEORGE F. SCHEIB (Fond du Lac, Wis.): This is certainly a very important subject. Dr. Wright referred to the surgeons of the Northwest sending cases to the oculist in good shape, and I want to say that the general practitioners in Fond du Lac do not touch an injured eye, but send it to the oculist right away; therefore we cannot blame them for any complications.

The subject is one that impresses everybody with its seriousness; not only general practitioners, but the laity themselves are very solicitious over an eye injury, however insignificant it may be. One thing that I think we should impress upon our patients, the public, and the general practitioners as well, is the fact that the very first aid to even a small foreign body in the cornea is often the starting point of an ulceration which leads to very serious complications.

The majority of ulcerations coming under my care have been due to the manipulations of men in endeavoring to relieve their fellow workmen of a foreign body; for example, taking a match, a toothpick, or some instrument around the shops and endeavoring to help the fellow out of his trouble. This is the starting-point of many of our eye troubles. The question resolves itself down to the principle that has been expounded here this morning in reference to fracture of the patella, the management of contused wounds, and their treatment: i. e., asepsis. This is important in all kinds of surgery, but particularly so in eye work. If the eye surgeon is aseptic and has instruments thoroughly boiled there is very little danger from manipulating the eye, because we cannot touch that eye with the fingers. If a patient comes to us with a foreign body in the eye, we do not use the fingers; we use the spud or some other instrument to remove it. And there is no question but that the instrument selected can be sterilized because we can use heat, but we cannot always sterilize our fingers thoroughly.

Eye injuries may be divided into two classes: non-perforating and perforating. Non-perforating injuries are, of course, more common than the others.

Non-perforating Injuries.—Contusions and blows upon the eye are sometimes very serious. If the blow strikes the ciliary region, which is considered the danger-zone of the eye, the prognosis is certainly indefinite, because sympathetic ophthalmia may develop at any time from three weeks to forty years

after an eye has been injured in the ciliary region. Therefore, contused wounds or blows upon the eye are very important so far as future complications are concerned. Severe cyclitis is bound to result in atrophy of the globe, and an atrophy of the eyeball is always, of course, a menace to the good eye.

Perforating Injuries.—However small a perforation may be, there are so many delicate structures in a small area—the lens, the iris and the ciliary body—that all may very easily become involved. Even if the perforation is no larger than the end of a tack it may go far enough to produce a cataract, and cataract of the lens may produce a glaucomatous condition. Another complication is prolapse of the iris. All those things have to be considered in every case.

The sum and substance of this matter of eye injuries resolves itself down to two important factors: (1) cleanliness of the wound, and, if a case of foreign body, cleanliness of the instrument used to remove it; (2) the structures involved in case the wound is a lacerating one. If the foreign body is a fragment from a hammer or chisel, the fragment enters and lacerates the eye so completely that there is no hope for future vision, there is danger of sympathetic ophthalmia, and the most conservative treatment in my opinion is to enucleate the injured eye and thus save the very sad sequelæ of sympathetic inflammation in the other eye and total blindness.

DR. CLARENCE E. LUM (Duluth, Minn.): I shall not attempt to discuss this paper, having just come in. Personally, however, I believe that all eye injuries should be referred to a specialist. It may seem strange, but I base this statement on experience, having seen a great many serious cases which, had they been properly attended to at first, would have recovered without complications.

DR. WRIGHT: I want to compliment the essayist particularly on one point which is very helpful, and that is the early use of the cautery after injury. But I would say, in honesty and for the purpose of bringing out discussion, that I must differ with the doctor on two points:

1. I do not believe that the symptom of tension is at all constant after a large foreign body has entered the eye. Personally, I have had cases in which there has been perfect tension; therefore, I believe that we are sometimes deceived if lowered tension is used as a diagnostic symptom of presence of foreign body.

2. Visual acuity being normal does not, I have found, justify me in believing that the injury is not serious, because many

times the acuity will be found normal with a large foreign body in the ciliary region. It may have entered through the sclera without the acuity of the eye being affected, and it would have been a serious mistake to accept normal visual acuity as proof against the presence of a foreign body, in my opinion.

I did not hear the *x*-ray spoken of. It seems to me that at this time, in any case of eye injury where there is cause to suspect that a foreign body is in the eye, without the *x*-ray picture we shall be held responsible for not doing what we should. Many foreign bodies show so well. The sideroscope is also useful in some cases.

DR. BARNES: It has been my experience—and I agree with Dr. Wright—that neither with normal tension nor with normal visual acuity are we justified in assuming that there is no foreign body in the eye. Even if you have normal visual acuity it does not necessarily follow that there is not a foreign body of considerable size in the eye, because I have seen eyes that had in them quite a large sliver of steel which had been there for some time, and still visual acuity was perfect.

Along this line I have two cases in which the opposing results seem strange. In one a cataract has formed; in the other there is no cataract. In the last-mentioned case, that of a workman, a piece of steel at least one-quarter inch long, a very thin, long sliver of steel, went directly through the cornea and became entirely imbedded in the lens. I removed it with a giant magnet and told the patient he would have traumatic cataract. To my surprise he never had the least suspicion of a cataract. That is the most unusual case I ever saw. Of course, he was very much gratified, while I was somewhat chagrined, for I had been so positive in my prognosis that he rather had the laugh on me.

Soon after this a boy came in with an injured eye. With some companions he had been throwing darts. The boy was not as good a marksman as he ought to have been, and his dart landed in this boy's eye, right in the center of the cornea. It was no larger than the sliver of steel that went into the workman's eye, and still the boy rapidly developed a complete cataract. I operated early, and the cataract has entirely disappeared. The first case mentioned is the only one I have seen in which traumatic cataract did not ensue after a foreign body was imbedded in the lens.

I do not know as I want to take issue exactly with the essayist as regards removing a foreign body in the cornea with a toothpick, but I must say that I believe it is rather better prac-

tice not to do it. While you can do it, in the large majority of cases in which a foreign body of any nature is imbedded in the cornea I believe that you are going to produce added traumatism and abrasion of the superficial epithelium by making a sudden circulatory motion, as you have to, right straight across. I think all foreign bodies should be removed with a spud, for the reason that you can make that perfectly sterile, and at the same time that you remove the foreign body you can curet and remove all possible chance of infection. It makes no difference what the foreign body is,—a cinder, a small speck of steel, a piece of emery, or anything of that nature; when it imbeds itself in the cornea there is always a chance that it will carry in some germ whereby you will get a bad ulceration. Therefore it is my practice to use a spud and curet, afterwards cleaning out thoroughly with argyrol and ending up by applying to the little wound that has been made the tincture of iodin. This is rather heroic treatment for a few minutes, but the patient does not notice it much because the eye is under cocaine. In only one case after this routine treatment have I ever had serious ulceration following removal of a foreign body from the cornea, and this was the patient's fault. A very minute speak of dust lodged in his eye. He did not report to me the next day, as I had told him to do, and in twenty-four hours he had developed an ulceration that very rapidly went on to almost perforation, and he was laid up six weeks.

In the usefulness of the cautery in treating these conditions I thoroughly agree with the essayist and Dr. Wright. Cauterization of ulcers is, I think, a very fine practice, and I have always used it as a routine. But of late years I have changed somewhat and now use sub-conjunctival injections of normal salt solution instead of cauterization. I first clean the eye out thoroughly, then use sub-conjunctival injections of normal salt solution, dust the wound or ulcer with xeroform, close the eye, and do not open it for at least three days. The first dressing shows a wonderful improvement in the condition of ulceration. Therefore I have in the last three years given up cauterization and entirely made use of sub-conjunctival injections. The normal salt solution is, also, just as good for cleansing as anything we have.

The giant magnet is extremely useful in locating foreign bodies in the eye, as are also the sideroscope and *x*-ray. There are, however, certain forms of steel upon which the giant magnet does not have any effect. Nevertheless, in the large

proportion of cases the giant magnet will demonstrate a piece of steel in the eye.

DR. URQUHART (closing the discussion): I thank Drs. Wright and Barnes for bringing up the points which they did. There are undoubtedly exceptional cases of penetrating injuries in which the tension is not lowered but, generally speaking, lowered tension is a valuable diagnostic sign in recent penetrating injuries.

When there is not external evidence of a serious injury to an eyeball, the visual acuity will give you a fairly good idea of the severity of an injury.

In regard to the removal of foreign bodies, lodged in the cornea, with a spud: I think the spud is probably the best, providing the operator is accustomed to doing that work. But for general surgeons, if a little cotton is twisted tightly around a sharpened toothpick, most foreign bodies can be removed without producing any further injury.

STUDIES IN BLOOD-PRESSURE BEFORE, DURING, AND AFTER OPERATIONS, WITH REFERENCE TO THE EARLY RECOGNITION, PREVENTION, AND TREATMENT OF SHOCK

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The evidence available at the present, while by no means sufficient to prove, is yet enough to indicate, that we have made great advance in the early recognition, prevention, and treatment of shock due to operative interference.

There are two factors in shock over which we have the greatest control: the toxic factor due to the anesthesia, and the traumatic factor due to the operative manipulations. Our knowledge of these factors has been gained from experimental investigations on animals and careful clinical observations.

In the beginning of anesthesia, chloroform was the anesthetic of choice. It seemed to have advantages over ether. It was more easily administered; the patient became narcotized with less struggling and was more relaxed during the operation; and the postoperative discomforts were less. But it was soon found that chloroform had distinct dangers. It is more toxic than ether; under its administration the

blood-pressure falls more rapidly; sudden deaths occur during its administration and are not infrequent at intervals after an apparent complete recovery from the anesthesia. These late deaths are due to certain cell-changes dependent upon the toxic action of chloroform. The longer a patient is kept completely narcotized by chloroform, the greater the immediate and later dangerous effects.

These observations gradually led to the substitution of ether for chloroform as the anesthetic of choice. It must have been these dangers that were the paramount factors in the change because ether is more difficult to administer, and the time required to get the patient completely narcotized is longer; distressing complications during the administration are more frequent, such as cyanosis and locking of the jaws; the after-effects of ether are more disagreeable than those of chloroform, and ether is more expensive than chloroform. Nevertheless, in spite of these apparent disadvantages, ether won out, because careful observations demonstrated that it had real advantages on the side of safety.

The administration of ether attained its highest perfection in the so-called "drop-method" on an open cone.

Surgeons, however, were not satisfied and sought for other methods of anesthesia which would eliminate the discomforts and dangers of the perfected method. This dissatisfaction led to various forms of local anesthesia, spinal anesthesia, intravenous, and rectal anesthesia.

Surgeons, having become convinced that the chief danger of ether was its toxic action and finding that many operations were impossible under local anesthesia alone, searched for a general anesthetic whose action was less toxic, or not toxic at all.

Apparently, nitrous oxid and oxygen up to the present time is the general anesthetic with the least toxic effect. As a matter of fact we have no proof that it has any toxic action.

In the beginning this gas was employed without the oxygen as an introductory to ether, simply to shorten the period of the anesthetic time. It was soon found that it had no advantage in reducing the amount of ether administered. Then attempts were made to perform longer operations under nitrous oxid alone. This led to the introduction of oxygen, which allowed a longer anesthesia with less cyanosis.

The combination of local anesthesia with general anesthetics, such as chloroform and ether, has long been employed. The object, however, of this combination was to reduce the amount of the general anesthetic to a minimum. Those who employed it did not have in mind that the local infiltration was also of an advantage in reducing traumatic shock dependent upon the local injury in the operative manipulations.

Operators, of course, have been familiar for a number of years with the fact that there is a definite factor in shock, due to the cutting, tearing, and handling of tissues during operations; but they seem to have devoted less attention to the reduction and elimination of this factor than to the toxic factor of the anesthetic. They have been prone to blame the anesthetic for their operative and post-operative shock, its mortality and complications, rather than to place some of the odium on their own manipulaions.

When I came to Dr. Halsted's clinic at the Johns Hopkins Hospital, in 1892, I found that he had very definite ideas of his own in regard to shock, different from those who had been my teachers in surgery and from the ideas that I had gained from reading up to that time. He perhaps emphasized most the factor of hemorrhage, and his operations were more bloodless

than any I had ever witnessed until then. He was also of the opinion that tissues should be handled gently—cut, not torn; that, in clamping, the bleeding point only should be caught, and not large masses of tissue crushed; that larger wounds should be made, because through these the necessary manipulations could be more gentle. Apparently, he had in mind by these manipulations not only the reduction of shock due to trauma, but the better healing of a wound in which the tissues were less injured. He also endeavored to operate with the least amount of ether possible.

Dr. Halsted was among the first, perhaps the first, to practice local anesthesia, because it was safer.

When I began to investigate surgical shock and critically to review the literature (*Progressive Medicine,* December, 1899, p. 151), I read and reviewed the "Experimental Work on Surgical Shock" by George W. Crile (J. B. Lippincott & Co., Philadelphia, 1891). This essay was awarded the Cartwright prize in 1897.

It is my opinion that we owe to Crile, more than to any other writer, our knowledge of the factors which produce shock and of the early recognition, prevention and treatment of this definite surgical complication. In these sixteen or more years Crile has continued his experimental investigations and has added to them a great clinical experience. This has resulted in the development of a definite technic,—a combination of local and general anesthesia.

The paramount object of this new technic is to reduce the toxic action of the anesthetic and the traumatic factor of the operative manipulation to a minimum. The technic consists of a general anesthesia by nitrous oxid and oxygen, with little or no ether, and an infiltration of all the tissues divided and handled by 1 :400 novocain.

This technic makes the operative time longer; it puts more labor on the surgeon; it requires infinite patience. I am confident that this technic will never become popular until it is clearly demonstrated that it does reduce shock, and that it reduces operative mortality, post-operative discomforts, and complications, and shortens the period of disability due to the operation.

For more than three years I have attempted to employ this method in every operation. In the majority of cases I have a complete record of the pulse and the blood-pressure before, during, and after the operation, with notes on the behavior of the patient in relation to the operative manipulations.

Fig. 1 represents the anesthetic chart now employed. In the middle column the pulse and blood-pressure are recorded every five or ten minutes; the respirations are also recorded in their proper place. In the column to the right the one in charge of the anesthetic chart notes from the dictation of the surgeon the various operative manipulations, for example, skin incision, peritoneum opened, mesentery pulled on, division of stomach, etc. In the left-hand column there is noted from dictations by the anesthetist and surgeon the condition of the patient and any change in the method of administration of the anesthetic, for example: gas started, infiltration with novocain, patient quiet, color good; patient cyanotic, patient moves or struggles; vomiting; gas off; 20 drops of ether given; morphin hypodermatically, gr. $\frac{1}{10}$; subcutaneous infusion of salt, strophanthin intravenously; etc.

In this way we have a graphic record of the effect on pulse, blood-pressure, respiration, and the condition and action of the patient during the operation of the definite operative manipulations. I shall discuss these more in detail later.

From my own observations I am convinced that any operation performed under this method of anesthesia, properly done, will result in less shock; there will be a lower mortality; the post-operative discomforts and complications will be greatly reduced, and the period of disability very much shortened.

This has certainly been accomplished in my own experience, and I think I have convinced my associates, both surgeons and nurses, that this method has great advantages over ether.

I am also confident that no operating surgeon will come to the same conclusions until he has faithfully given this method a fair trial over a considerable period of time.

It is important, in the first place, to emphasize to you that success depends perhaps most on your technic of local infiltration. No surgeon who has not performed many operations under local anesthesia alone will be able to get the same results from this combined method. When the patient is awake, and you attempt the operation under local anesthesia, you will always be informed when a painful act takes place, and you will be surprised at the difficulty of making such a local infiltration operation painless. Very few surgeons in this country have educated themselves in the difficult technic of local infiltration. They are not familiar with the sensitiveness of the different tissues and with the varying degrees of discomfort from different manipulations. It is my opinion that the first step in the development of this technic is to perform as many operations as possible under local anesthesia.

Under nitrous oxid and oxygen general anesthesia the patient, as a rule, moves when any very painful step is performed, but not for the less painful manipulations, so that, if you begin with general and local anesthesia, you will be aware only of the more severe traumas, and you will by no means block all painful

afferent sensations. And as the patient only moves and does not cry out, one will more naturally be less influenced. The simple introduction of 1:400 novocain here and there will by no means accomplish the result.

When the patient is anesthetized with ether or chloroform, he does not move when painful manipulations are made, and many surgeons are of the belief that such painful stimuli do not produce the same effect upon the nerve-cell as when the patient is awake. A careful study of the blood-pressure records during the operation and the post-operative convalescence will disprove this.

General anesthesia apparently obliterates only the psychic shock that would be present if the patient were awake. We have no proof that the traumatic shock from the painful wound-insults are reduced by general anesthesia. The evidence is all in favor that the results are the same.

Theoretically, the entire field of operation should be so blocked by local anesthesia that the brain-cells receive no sensory impulses. This is not possible in all operations. For this reason a general anesthetic is necessary. If one could completely block these impulses, and the patient had no fear, a general anesthetic would be superfluous. The endeavor of the surgeon therefore should be to reduce the sensory impulses from the wound to a minimum.

The difficulty of proving that this method of anesthesia lowers mortality, reduces post-operative complications and discomforts, and shortens the period of disability, is due to the fact that, in the first place, the records of many clinics are not sufficiently accurate and complete to allow a statistical study. In the second place the mortality and other complications are relatively small for the majority of operations upon the average patient.

Even with rather bad ether narcosis and rough operative manipulations the mortality and other complications are not large when studied in the aggregate.

With ether narcosis by the perfected method in the hands of an expert, and when the operation is performed by a skilled surgeon rapidly without local anesthesia, we have reason to believe that the mortality and complications are reduced.

The majority of surgeons apparently agree that, given the same operative skill and experience, the chances are better with ether as an anesthetic than with chloroform, and still better when the ether is given by the perfected drop-method by an expert.

We therefore must compare this method of combined local and general anesthesia with our results under the perfected ether method by a skilled anesthetist, but without local anesthesia.

For the ordinary operation upon the healthy individual the difference in mortality will be slight, but, I am confident, a great difference will be found in the post-operative complications and discomforts and in the period of disability.

The mortality from shock after grave operations upon healthy and handicapped individuals is one that becomes very striking when these groups of cases are studied separately. I am certain from my experience that this combined method of anesthesia will reduce this mortality.

The mortality of simple and ordinary operations upon patients whose resistance before operation is lowered by various factors, is by no means insignificant, and here I am also sure that this more difficult method of combined anesthesia will lower the mortality.

We have in the literature no available statistics as to these facts. The investigation must at first be a chiefly personal one. Each surgeon must familiarize

himself with his own results in the different groups and then see whether there is improvement when the operations are performed under a combination of nitrous oxid and oxygen general anesthesia and local infiltration with 1:400 novocain.

This brings me to the most important point in this discussion.

In order to perfect this method of combined anesthesia, it must be employed in every case, and then, after a large number of observations have accumulated, the surgeon will be in position to compare the results.

Every patient must be looked upon as handicapped and extremely ill. Every operation must be considered a grave one. Every detail of the technic should be carried out conscientiously. Surgeons will find that this requires time. The surgeon will either have to work more hours in the day or perform fewer operations.

In my own experience I have observed, first, a most distinct improvement in the post-operative convalescence. Pneumonia, thrombosis and phlebitis, gas-pains and distention of the abdomen, acute dilation of the stomach, anuria and nephritis, have become distinctly less. Now, as a matter of fact, the graver of these complications were not very frequent after good ether anesthesia. It is only when one studies the smaller group of handicapped individuals and graver operations that the difference becomes more evident.

The lessening of the ordinary post-operative discomforts, which cannot be looked upon as grave complications, is the most evident feature.

To prove that the mortality is less is the most difficult of all. I am quite certain that in resection of the colon and stomach for ptosis and complications we shall be able to prove the lessened danger of this

operation when performed under this combined method of anesthesia. As I am about to publish my observations on fifty such cases, I shall leave for that paper the burden of the proof.

The various factors that enter into the question of estimating how to reduce mortality and post-operative complications and discomforts, and shorten the period of disability, are so numerous, and each one of such importance, that it is not out of place here to mention them. The simple substitution of nitrous oxid and oxygen for ether and the routine employment of local infiltration, are by no means sufficient to accomplish the results hoped for.

The patient must be prepared properly—mentally and physically—for the operation. I have discussed this in a paper entitled "Estimation of the Vital Resistance of Patients with Reference to Possible Recovery After Surgical Intervention" (*Annals of Surgery,* May, 1912).

The period of time between the onset of the disease and the operative relief is an important factor. In some cases it is the essential factor, and if this is not considered in the study of mortality, our conclusions may be misleading. For example, very early operations for intestinal obstruction under ether narcosis without local anesthesia would probably show less mortality than late operations for the same condition under the most perfect combined local and gas anesthesia. But my own statistics show that if we consider the cases of intestinal obstruction operated upon late, we shall find that the mortality after ether narcosis is distinctly greater than after a local alone, or a combined local and gas anesthesia. But even in this group another factor must be considered—whether enterostomy was performed or not. If the operator, with his improved method of anesthesia, failed to perform enterostomy, while the operator with bad ether anes-

thesia did, the latter's results would probably be better.

These examples show the importance of considering all the factors of safety when we attempt to get at the methods which yield the best results.

The condition of the patient before operation depends upon many factors. As a rule, the earlier the intervention, the better the results. I have attempted to show this in a previous communication ("On the Medical Aspects of Surgical Diseases; or, Preventive Surgery," *Jour. of the A. M. A.*, March 23, 1912, p. 829).

In conclusion we may sum up the question with the statement, which apparently cannot be controverted, that there is a mortality, an increase in the number and severity of post-operative complications and discomforts, and a lengthened period of disability due to operative shock. The factors are psychic, due to fear; toxic and traumatic, due to the condition before operation; and psychic, toxic, and traumatic, due to the operation itself. These factors may continue after operation.

There is no question that we wish to improve our results. To accomplish this, all the factors must be borne in mind.

The absolute proof that the substitution, for ether, of nitrous oxid and oxygen, combined with local anesthesia, will rest at first upon a personal investigation by the individual surgeon. We have not yet reached the stage where comparisons with the results of different surgeons will be as helpful, because, as yet, it seems impossible to get at all the factors which enter into the problem.

To obtain the best results, every surgeon must attempt to improve all of his methods, to get his patients earlier, to study more carefully the preparation for operation, to improve his general and local anesthesia, to improve his own technic, and to study and make

better his post-operative treatment. Then, and only then, will he observe, and be able to estimate, the factor of the toxic shock from ether and the traumatic shock due to operation without local infiltration.

Fig. 1 (Rabinowitz) is a chart taken during the resection of the right half of the colon. The anesthetic was gas and oxygen combined with local infiltration of 1:400 novocain. The full time of the operation was two hours and forty minutes. You will notice practically no change in pulse or blood-pressure. Throughout the operation the patient had a good color. You will note that during the separation of the cecum and colon, when some tension was put on the mesocolon, the patient moved a little and that there was slight locking of the jaw; the blood-pressure rose slightly. When the transverse colon was divided with the Paquelin, some slight tension was again placed on the mesocolon, and the patient reacted in a similar way. With these two exceptions the patient was absolutely quiet throughout the operation. Not a drop of ether was given. From the behavior of the blood-pressure and the patient we can be quite confident that no very painful manipulations were carried out. This patient had a greatly dilated duodenum, due to a ptotic cecum pulling on the mesentery of the small intestine because of the shortness of the mesentery of the ileum near the cecum. She had been an invalid for seven years; gastric symptoms with vomiting had been present one year. She had lost weight; was anemic and very nervous; the kidney function, however, was unimpaired, and there was no evidence of a cardiac lesion. Here, therefore, we have a grave operation performed upon a somewhat handicapped patient. Her condition at the end of the operation was as good as after an ordinary thirty-five minute appendectomy performed under ether narcosis. I have discussed this lesion—chronic

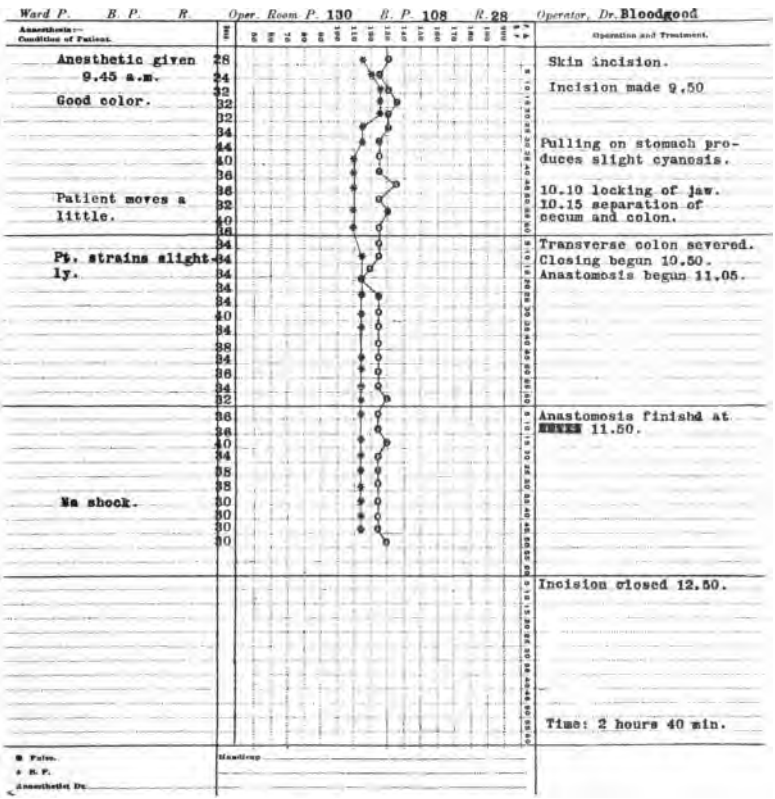
Ward P. B. P. R.
Oper. Room P. 130 B. P. 108 R. 28
Operator, Dr. Bloodgood
Anesthesia—Condition of Patient.
Operation and Treatment.
Anesthetic given 9.45 a.m.
Good color.
Patient moves a little.
Pt. strains slightly.
No shock.
Skin incision.
Incision made 9.50
Pulling on stomach produces slight cyanosis.
10.10 locking of jaw.
10.15 separation of cecum and colon.
Transverse colon severed.
Closing begun 10.50.
Anastomosis begun 11.05.
Anastomosis finishd at 11.50.
Incision closed 12.50.
Time: 2 hours 40 min.
Handicap

Fig. 1.

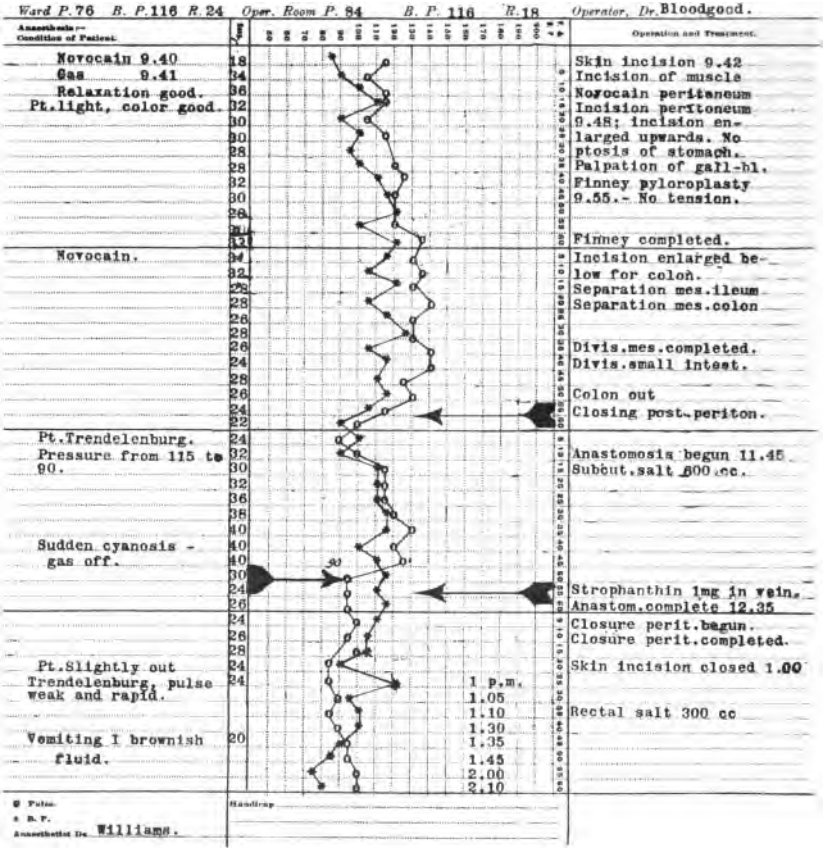
Ward P.76 B. P.116 R.24 Oper. Room P. 84 B. P. 116 R.18 Operator, Dr. Bloodgood.
Anesthesia — Condition of Patient.
Operation and Treatment.
Novocain 9.40
Gas 9.41
Relaxation good.
Pt.light, color good.
Skin incision 9.42
Incision of muscle
Novocain peritaneum
Incision perltoneum
9.48; incision en-
larged upwards. No
ptosis of stomach.
Palpation of gall-bl.
Finney pyloroplasty
9.55.- No tension.
Finney completed.
Novocain.
Incision enlarged be-
low for colon.
Separation mes.ileum
Separation mes.colon
Divis.mes.completed.
Divis.small intest.
Colon out
Closing post. periton.
Pt.Trendelenburg.
Pressure from 115 to
90.
Anastomosis begun 11.45
Subcut.salt 800 cc.
Sudden cyanosis -
gas off.
Strophanthin 1mg in vein.
Anastom.complete 12.35
Closure perit.begun.
Closure perit.completed.
Pt.Slightly out
Trendelenburg, pulse
weak and rapid.
Skin incision closed 1.00
Rectal salt 300 cc
Vomiting I brownish
fluid.
1 p.m.
1.05
1.10
1.30
1.35
1.45
2.00
2.10
Handicap
Anaesthetist Dr. Williams.

Fig. 2.

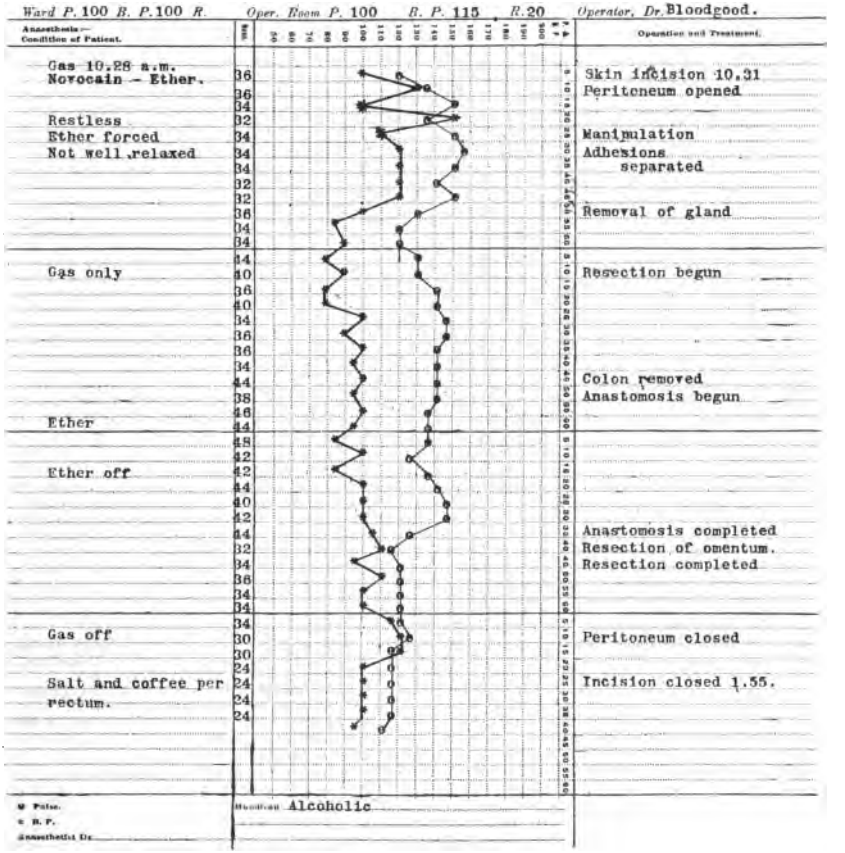
Ward P. 100 B. P. 100 R.
Oper. Room P. 100 B. P. 115 R. 20
Operator, Dr. Bloodgood.
Anaesthesia — Condition of Patient.
Operation and Treatment.
Gas 10.28 a.m.
Novocain — Ether.
Restless
Ether forced
Not well relaxed
Gas only
Ether
Ether off
Gas off
Salt and coffee per rectum.
Skin incision 10.31
Peritoneum opened
Manipulation
Adhesions separated
Removal of gland
Resection begun
Colon removed
Anastomosis begun
Anastomosis completed
Resection of omentum.
Resection completed
Peritoneum closed
Incision closed 1.55.
Alcoholic

Fig. 3.

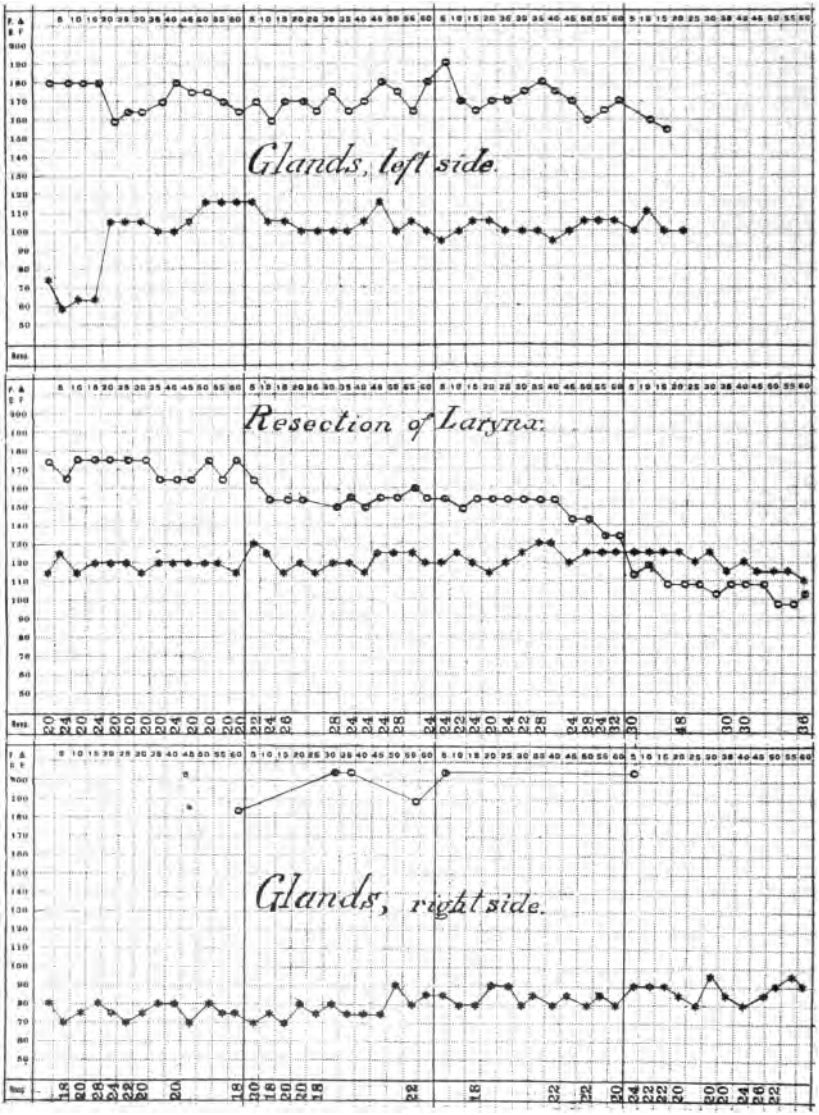

Fig. 4.

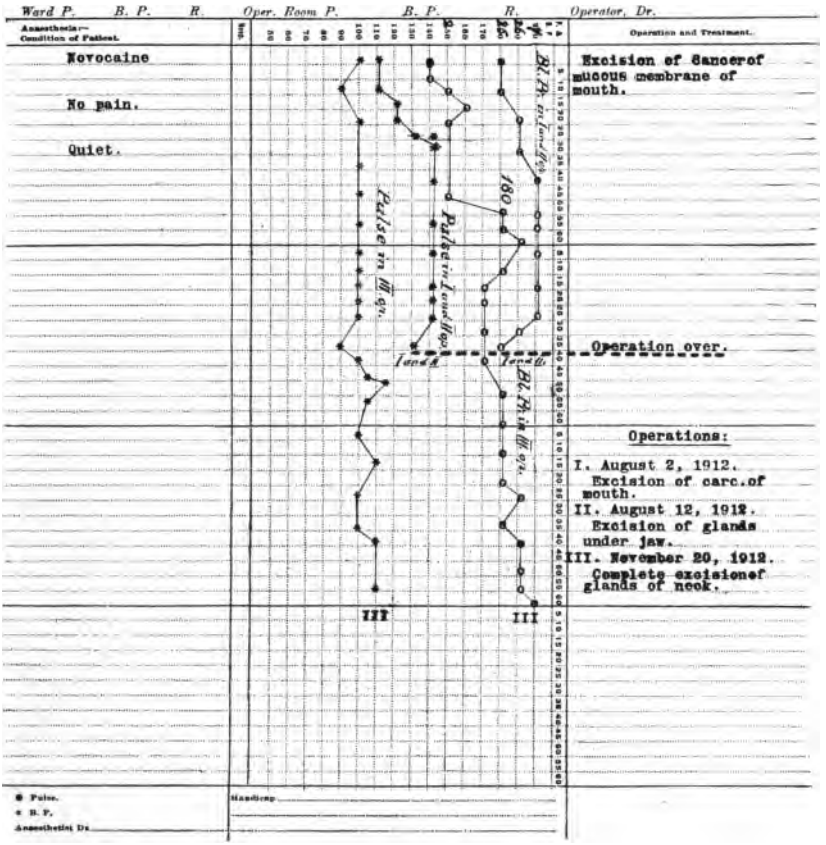
Ward P.
B. P.
R.
Oper. Room P.
B. P.
R.
Operator, Dr.
Anaesthetic—
Condition of Patient.
Operation and Treatment.
Novocaine
No pain.
Quiet.
Excision of Cancer of mucous membrane of mouth.
Operation over.
Operations:
I. August 2, 1912.
Excision of carc. of mouth.
II. August 12, 1912.
Excision of glands under jaw.
III. November 20, 1912.
Complete excision of glands of neck.
Pulse in lt. q.
Pulse in Lower lt. q.
Lt. Rib lift q.
III
III
Pulse.
R. P.
Anaesthetist, Dr.
Handicap

Fig. 5.

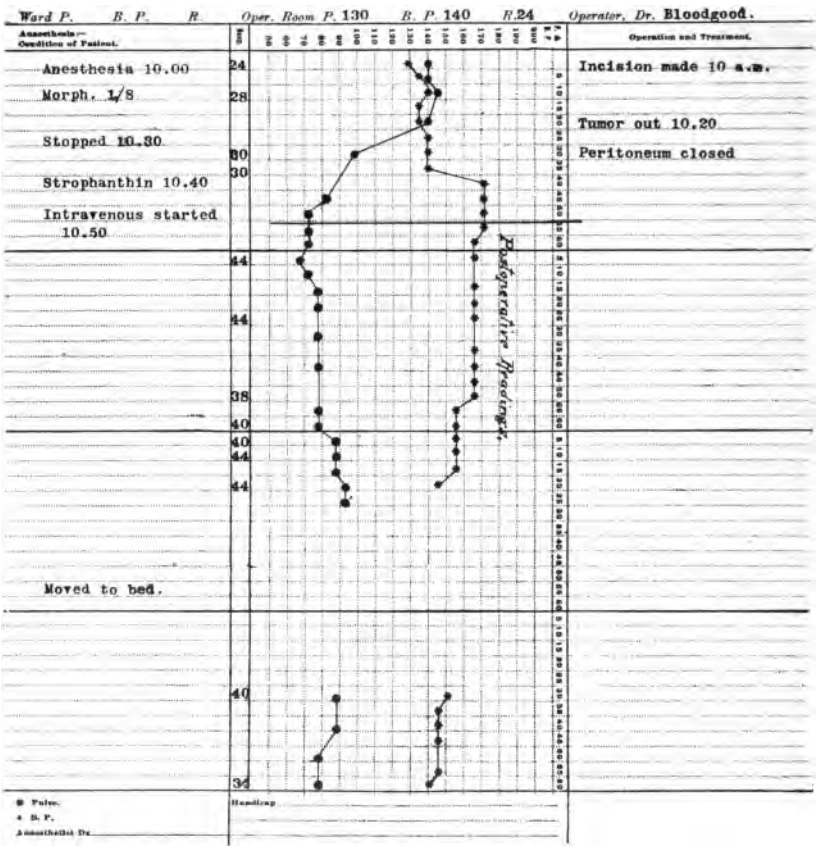
Ward P. B. P. R.
Oper. Room P. 130 B. P. 140 R. 24
Operator, Dr. Bloodgood.
Anesthesia — Condition of Patient.
Operation and Treatment.
Anesthesia 10.00
Morph. 1/8
Stopped 10.30
Strophanthin 10.40
Intravenous started 10.50
Incision made 10 a.m.
Tumor out 10.20
Peritoneum closed
Postoperative Readings.
Moved to bed.
Pulse.
T. P. R.
Anaesthetist Dr.
Handicap

Fig. 6.

gastromesenteric ileus—in the *American Journal of Gastro-Enterology* (July, 1912).

Fig. 2. In this case the patient also had a chronic gastromesenteric ileus; in addition, here was pyloric stenosis, due to a healed ulcer. So that, in addition to the resection of the right half of the colon, a Finney pyloroplasty was performed. You will note that the operation required three hours and twenty minutes; no ether was given; the patient took the gas and oxygen well; and local infiltration with 1:400 novocain was employed throughout the operation. The general condition of this patient was not as good as in the previous case; she had been bedridden for nine months and had existed practically on buttermilk only. She was extremely emaciated, with quite marked secondary anemia. The kidney function was good, and there was no cardiac lesion. You will note that during the Finney pyloroplasty, done practically without tension, the pulse and blood-pressure varied more than in the previous case during the first hour. This was due, probably, to the palpation of the gall-bladder and investigation of the condition of the pancreas and duodenum. You will note that in the second hour during the entire time while the colon was being resected the pulse and blood-pressure showed but slight variations. Even these slight variations, as compared with those in the previous case, indicated to the operator that he was dealing with a patient with but slight factors of resistance. This is shown on the chart at the position of the first arrow. In closing the rent in the peritoneum, left after the removal of the colon, one must handle most sensitive tissue in an awkward position in the depth of the wound. Although this required but ten minutes, you will note that the blood-pressure fell from 115 to 90. We then placed the patient in the Trendelenburg position and observed an immediate rise in the

blood-pressure. During the anastomsis between the ileum and colon the blood-pressure remained good, but just as we began to handle the wound for closure, it again fell, and the patient was given strophanthin, 1 mg., into the vein. I have found that this drug is helpful to maintain blood-pressure, and I give it when the blood-pressure falls below 100, and when there is no reaction after lowering the head and giving subcutaneous salt. You will note on the chart in this case that both of these measures of protection had been employed. Just previous to this fall in the blood-pressure the patient showed cyanosis, and for this reason the gas was immediately discontinued, and the remainder of the operation performed under local anesthesia alone.

We have, therefore, in this case, at the end of the operation, a moderate degree of shock from which the patient gradually and completely recovered. When the operation was completed on this individual she was relieved of a great handicap—the pyloric stenosis, the duodenal dilatation, and the toxemia from the right giant colon. She could take and retain nourishment almost immediately. There was no toxic substance, such as ether, to be eliminated. In my experience, I would not have attempted this operation under ether narcosis. I am confident that in this individual a rapid appendectomy under ether would have been more serious than the operation as performed, and her convalescence more uncomfortable. I look upon this case as an extreme test of the method.

Fig. 3. This chart is one made during an operation upon a male patient in good general condition. The right half of the colon was resected because of post-operative adhesions secondary to appendectomy. The patient suffered from pain and partial intestinal obstruction. When there are adhesions about the colon it is more difficult to remove it with-

out pulling on the parietal peritoneum, and it is very difficult to infiltrate large areas of this peritoneum. In this case this was apparently done successfully. The fall in blood-pressure to about normal, as shown in the chart, took place after all painful manipulations had ceased.

The operation in this instance must have been painful, because you will observe that we had to give a little ether. Painful manipulations always at first increase the blood-pressure. This patient, although in better general condition than the previous two, had a more uncomfortable convalescence, which I attributed to the small amount of ether and the painful manipulations which we could not block. The details of this case will be discussed in a second paper already referred to.

I do not feel that I have, as yet, accomplished the utmost in the local infiltration of the posterior parietal peritoneum and mesentery in the operation for the resection of the colon and stomach.

Fig. 4. This chart portrays three separate operations. Each operation was done entirely under local anesthesia with novocain. The patient was suffering from an advanced carcinoma of the larynx. The first operation consisted of the removal of the glands on the right side with the sternocleidomastoid muscle and internal jugular vein. All the nerve-trunks coming out between the muscles of the neck were blocked. You will note that it was a long and tedious operation, lasting four hours. The blood-pressure in the first and last hour is not recorded, because the apparatus had to be used on another case. There was absolutely no post-operative shock, nor any complications. The record of the operation on the glands of the left side of the neck is complete—an identical operation with a similar result. The third operation consisted of the resection of the larynx, performed

without tracheotomy and with closure of the pharynx at the end. This operation was not absolutely painless, and you will note the fall in the blood-pressure after the third hour. The shock was slight, and the patient made an uncomplicated recovery. The only handicap in this case was the almost occluded larynx. For this reason I did not use a general anesthetic.

Fig. 5 represents a composite chart of three operations under novocain alone. The handicap was a marked arteriosclerosis with high blood-pressure, a cripplied heart with marked dilatation of the aorta, albumin and casts in the urine, and a low kidney-function. The pulse and blood-pressure in the first two operations were so nearly alike that they are recorded together. These operations required about one hour and three-quarters. You will note that in the third operation, although longer (three hours), the pulse and blood-pressure are lower. This may be explained from the fact that the patient, due to the rest and environment of the hospital, had improved as far as his high blood-pressure was concerned.

The first operation consisted of the excision of a cancer of the mucous membrane of the cheek, the second of the removal of the glands under the left side of the jaw, the third of the removal of all the glands from mastoid to clavicle with the sternocleidomastoid and internal jugular vein.

These two charts portray what is possible under local anesthesia alone. Both patients had unusual self-control for local anesthesia and desired to get along without a general anesthetic, because of the added danger.

My experience up to date with gas in high blood-pressure has been most favorable, but not sufficient to test in this case (Fig. 5) if I could get along without it.

I shall reserve for a future communication the discussion of the apparent advantages of nitrous oxid and oxygen over ether in high blood-pressure.

Fig. 6. Here we have a graphic chart of shock due to trauma and loss of blood. This patient had a huge tumor beneath the psoas muscle in the left iliac fossa. It proved to be a benign fibromyxoma. He was taking twelve grains of morphin a day for pain when he came under my observation. I made up my mind to enucleate the tumor in stages, packing gauze between its capsule and the surrounding tissue. This chart was made at the last (tenth) operation. The final enucleation, you will note, required but twenty-five minutes. As the tumor was lifted from its bed there was profuse hemorrhage, and you will see the marked rise in the pulse and the fall in the blood-pressure. Fortunately, we were able to check the hemorrhage at once by packing. The patient recovered and is now well.

It seems unnecessary to reproduce here more charts. I look upon this paper as simply an introduction, with the hope that it will influence you to try the method.

The final proof will rest upon a careful study of groups of operations of the same kind. These I propose to publish shortly. I feel convinced that I have sufficient evidence to prove that this method will be life-saving, if all the other factors of safety are considered in operations in the late stage of intestinal obstruction; in patients who have to be operated on when in a condition of shock after an injury; in the late stages of perforated gastric and duodenal ulcer and typhoid perforation; in resection of the stomach and colon for ptosis; in resection of the stomach for cancer and ulcer in patients weakened from prolonged pyloric stenosis; in the radical operation for cancer of the uterus; and in the combined abdominal and sacral operation for cancer of the rectum. I think I can also

show that the mortality will be decreased when less formidable operations are performed on patients handicapped with lowered kidney-function, with sepsis, especially cases of cholangitis and jaundice; patients suffering with diabetes and arteriosclerosis; high blood-pressure from various causes; in the presence of pneumonia and bronchitis; and in patients feeble with very advanced age. I have, as yet, not had sufficient experience with infants and young children. I am confident in these cases one should employ local infiltration, but we may find that ether given by the drop-method is just as safe. Our limited experience with children is due to the fact that the number of cases is small, and we have not yet perfected the mask. My experience so far with children between 5 and 10 years of age is most satisfactory with the combined method.

DUTIES OF THE LOCAL SURGEON TOWARDS THE COMPANY AND THE PATIENT

CONRAD E. NYSTRUM, M. D.

MEDFORD, WISCONSIN

The duties of a local surgeon begin when he signs his contract, and mean that he will protect the Company in all cases which he may be called upon to attend, as faithfully and with as much care as he would expect a surgeon to do for his own son, if employed by him. To see that nothing is undone that may assist in keeping the injured person on friendly terms with the Claim Department, who may approach him to adjust a claim or to see if the Company is responsible for the accident or injury. My experience has been that nearly 75 per cent of the cases asking for damages on account of injury claimed to be due to the negligence of the Company's employes, will be found, when sifted down, to be due to the patient's own carelessness or to the condition he was in at the time; some being under the influence of alcohol, others, after being out all night enjoying themselves, are in no fit condition of mind or body to work around or ride on moving trains. Again, they will do things which are against the rules of the Company, and will always keep that to themselves, as I have seen employes, as well as passengers, fly into a fit of anger on the least provocation, "slam-banging" everything. They did that while I watched them, and I have been surprised they did not get killed, or did not destroy thousands of dollars'

worth of property. You will find these are, generally, the fellows who get hurt first without any fault on the part of the Company.

Now, as local surgeons, how are we going to handle such persons, to keep them in the best frame of mind, being, as most of us are, in towns of from 600 to 2,500 population, with no hospital facilities or trained help to assist us to get the injured person into as normal a condition as surgical science can place him. We all know that the better we do our work and so get the best results, the more are we protecting our Company, and so will become the more valuable each year as surgeons.

We usually find our patient in a depot, a box-car, or on the side of the track, where his companions have placed him, with a curious crowd around making all sorts of remarks to disturb the tranquillity of mind of the injured one, not intentionally perhaps; but persons seeing bloody garments and features, draw the conclusion that the injury is a great deal more serious than it really is, and they make their remarks accordingly. Now, tell some level-headed fellow to have the crowd stand back to give plenty of air, and no harm will be done if you clear a space of five or ten rods. Get out of the car or room where your patient is, all curious ones, retaining a few of the most level-headed, the ones who say the least, for they will be of the most help. Stop any dangerous hemorrhage by ligating arteries, apply aseptic compresses or an Esmarch above the wound. Give ¼ to ½ gr. of morphin with 1/150 of atropin and 1/400 of strophanthin once in twenty-four hours, if necessary to combat pain and shock, but nothing by stomach during shock, as the stomach will not absorb during shock. Give the strophanthin intravenously, and be sure to exclude all air in the hypodermic syringe before the solution enters the vein, and sterilize the skin, syringe and

needle. Put on a temporary aseptic dressing and splints if needed. Get a room for the patient in a hotel or have your assistants carry him to his room or home, on a cot; if to a hospital, so much the better. Place hot-water bottles around him (I have found that empty fruit-jars filled with hot water serve the same purpose as hot-water bags), and see that they are not hot enough to burn the patient, by leaving the hand in contact with them for a minute.

Now, cheer him up by saying he is not hurt so very bad,—it could be worse,—and tell him you believe he will fully recover. This will have a tendency to put him in a cheerful frame of mind, and you never know how far it will help to put him back on his feet and give him implicit confidence in your work, thereby relieving a great deal of nervous tension which we all know is very depressing.

Have the room at 68° to 75°, plenty of fresh air; give the injured man half a glass or more of hot milk or coffee every four hours, and administer such remedies as your best judgment dictates for the patient. Keep everything quiet and leave a sensible, healthy nurse with the patient, the best you can get. Allow no one else in the room unless his wife or closest relative; instruct them to keep him thinking as little as possible about his injury; and if anything is said, insist that he will get as well as ever. But tell the Claim Department, also his nearest relatives, the exact condition and what in your best judgment they can expect as to his full recovery, warning them not to mention anything that may look serious to the patient, as it may take away his chances for full recovery. I believe a cheerful mind will go a long way in assisting in healing even a wound.

Take your blanks for the report and get his statement of the accident,—how it happened as nearly as he can tell,—and have him sign his name, and have his

signature witnessed. Then give as complete a description of the injuries as you can, avoiding medical terms, so that your statement may be plain. I have found a good way to do is to read it over carefully yourself and see if you have made a perfect pen-picture of the patient and his wounds, and, if so, mail it.

If patients ask questions, as they have of me on several occasions, as to compensation for injury, make the plain statement that you have no authority in that respect to shoulder any responsibility. Then when the claim agent arrives, do whatever you can to assist him in getting a truthful and honest report.

Now, as to operative work: I suppose most of you are working as local surgeons in the same position as I am, without any hospital or trained assistants.

The next step is to do what operative work is necessary.

Get another physician to give the anesthetic, if one is needed; get a trained nurse, if you have one, or some intelligent man to assist you (or physician if you can get one) to hold the patient and do such work as you can trust him with. Always carry a roll containing five or six sterile towels, two or three sheets with five yards of sterile gauze and sterile bandages wrapped in a sterile towel or sheet, including sterile rubber gloves wrapped well. This will keep sterile indefinitely. Include in this a sterile operating-gown. You can have several packages at the office for emergency cases, sterilized and dry; also carry a pint bottle of denatured alcohol, four oz. tr. of iodin, a roll of sterile cotton, one pint of benzine, green soap, and other antiseptics as needed, in operating-bag, including ether, chloroform, necessary instruments and hand-brush.

Now get a table; place a quilt, pillow, and blanket on the same, and have another blanket to cover the pa-

tient. Take down the curtains, if necessary, to get plenty of light; ask for a small table for instruments and solutions; also an oilcloth big enough to make a Kelly pad or to protect the body and clothing from solutions, and blood. Sterilize all pans or dishes to be used by putting denatured alcohol into them and setting it afire. Sterilize instruments by placing them in denatured alcohol for ten minutes. Scrub the forearm and hands with green soap and water. Next dip them in $\frac{1}{1000}$ sublimate solution. Let dry and apply sterile rubber gloves before operating.

Place the patient on the table, cover the wound with sterile gauze, cleanse the skin of all grease with benzine, and lastly, with denatured alcohol, and paint with iodin. Cleanse the wound with normal salt solution; pick out all foreign substances and put on a sterile pad while the patient is going under the anesthetic. I generally use chloroform followed by ether by the drop-method. Get your sterilized sheets; apply one over the small table, then place sterile gauze over the same. It is now ready for your instruments, sterile gauze sponges and dressings. Take the other sterile sheet; place it over the oilcloth and the patient; apply sterile towels around the limb to be operated on; if there is no operating-gown in the package, use a sterile sheet; pin the same around the neck; also sterile towel for head pinned under the chin and the back of the neck. Sterilize hands and forearms before putting on gloves. Now you are ready to do aseptic surgery in any room or house.

Trim away the tissues which seem to have an insufficient blood-supply; paint the wound with iodin, if you think it infected; suture the nerves and tendons, complete your operation, and apply your sterile dressings. Taking plenty of time to prepare before the operation and superintend every move yourself, then you are certain that your work has not brought any

infection into the operative field. Get your tissues as near to a normal condition as you can, and the nearer to perfection you can get a limb, the more you are protecting your Company and patient.

Getting near to normal perfection reminds me of a farmer I saw who had both legs fractured half way between the ankle and knee by both wheels of a wagon loaded with straw passing over them. I reduced the fractures and applied plaster casts. Next night I was called as he was in extreme pain. I opened the casts from top to bottom so as to have no pressure and told him to let me know if the pain did not cease in a few hours. The next day I was called in a hurry, the messenger stating the patient was dying of pain. When I got within half a mile of his farm I could hear him screaming. I took the casts off entirely and placed the legs between sand-bags. The pain ceased immediately, and he recovered with good union and strong legs; but to my consternation there was an ox-bow in each leg outward between the knee and the ankle. I thought this would be rather hard on me for him to walk around that way advertising my ability to get a bow-leg out of a straight one. So I said, "Mr. ——, I am very sorry to get such a bad result and such a big bow in both of your legs, but if I had left you in the straight plaster dressing you would have died from pain, so I had to place them between sand bags." He laughed and said: "They are as straight as ever. I was always bow-legged."

Return your patient to bed, place hot-water bottles around him and lower the head if there is any tendency to shock until the patient has reacted; leave but one cool-headed person in the room and allow no visitors until the patient is well enough to receive the same. Attend to all dressings personally unless you have a nurse whom you can thoroughly depend upon. Never be in haste to apply dressings until you have sterilized

everything, and I know your results will be all you can expect.

DISCUSSION

DR. JOSEPH C. BLOODGOOD (Associate Professor of Surgery, Johns Hopkins University): This is a very important paper. I do not know whether I should discuss surgery under the environment in which many railway surgeons have to practice it. But in the beginning of my surgical career in private practice we had not educated the people to come to hospitals, so we had to go to the people. And in the first three or four years I operated a great deal in the country, where they now have suggestions in regard to the simplification of technic that may be of value to you.

In the first place, denatured alcohol is very cheap, and you can carry in a flask a good deal of denatured alcohol. Take a small instrument-tray an inch deep and put in it one-fourth inch of denatured alcohol and you can sterilize in five minutes enough instruments to do an ordinary amputation. You can have a tray made long enough for your saw, which is the only long instrument. All of these dishes you speak of are of tin, and you can always get tin dishes in every house. Pour a little alcohol in the dish, touch it with a match, and the flame comes up and immediately disinfects the instrument. That is the technic I employ in my office for minor surgery. All instruments are sterilized by putting in alcohol and touching a match, instead of boiling. It is a rapid way of disinfecting instruments and basin, and you can carry in your satchel sufficient alcohol for any operation. Denatured alcohol is very cheap. It smells badly, and, fortunately, it tastes badly, so none of your employes will think of drinking it.

Boiling sheets and towels is, of course, the only method to employ for rendering our dressings sterile. But I believe every man who does surgery should have in his office a cheap sterilizing-pan. You can wrap in one sheet enough towels and gauze to make a bundle no longer than one foot, and six inches wide, which can be put in any ordinary satchel; and you can, if you haven't a lady assistant in your office, have half a dozen of these things. The objection to placing wet towels about yourself is, that you are in an over-heated room, and when you put a wet towel around you, you are in danger of catching cold. And the disadvantage of putting wet towels around the patient, with hot-water bags, is, that you run the risk of burning your hands, and the patient very quickly be-

comes chilled. I would suggest to every surgeon that he have this sterile sheet which he can open out on the table; the inside is clean and there are the towels and gauze and everything sterile. And you sterilize your instruments with alcohol.

There is one thing in the matter of disinfection which I would like to suggest: You have noticed, no doubt, that the surgeon sterilized the gown he covered himself with and the towel he put over his head. But it would be better for the patient if the surgeon's hand and arm were protected with a glove, and he would discard the gown and towel. I have just gone over the literature of treatment of accidental wounds, and that is why I feel I might perhaps give you a suggestion. When a surgeon makes an operative wound he feels responsible for it; but in the case of an accidental wound he feels that infection took place at the time of the accident. I am confident we can say today that in an ordinary accident in an ordinary environment outside a hospital, the only infection you need to fear is tetanus. The streptococci and staphylococci that produce infection of wounds, are not along the ordinary railroad track. The grease employed is a disinfectant, and you do not see them. Many of the infections that take place after an accidental wound are due to the hand of the surgeon who treated that case, and there is no method by which you can clean your hands except by covering them with gloves. The surgeon in general practice handles infected cases; his hands are more dangerous to the injured individual than any other thing that comes in contact with him. And so you should add to your armamentarium gloves that you can sterilize and place inside the sheet with the gauze, and if I were to suggest to your railroad company what they could best do for their surgeons, I would say to furnish them with rubber gloves, for they are expensive.

Another important point is that we exaggerate the danger of infection of the wound with everything else except our hands. With alcohol and iodin we can, I believe, give up soap and water in the cleaning of wounds in emergency surgery. I have frequently said in my teachings that in cleaning a wound with soap and water we use the wound for a dustpan. It is almost impossible to scrub and shave without getting the material in the wounds. It is safer, when you first see the injured person, to place a piece of sterile gauze over the wound, then paint the skin around the wound with iodin, after which I find it is better to rub that off with alcohol (which has just as good effect as iodin), then paint it again with iodin and leave that iodin on. Then devote your atten-

tion to the details, taking out foreign bodies, trimming away the tissue which has poor circulation, etc.; and you have saved time, for it takes a lot of time to scrub with soap and water, and it is of no use. Do not touch that wound with ungloved hand—that is far better than any other method of disinfection or antisepsis; cut out scrubbing with soap and water and use iodin and alcohol.

Morphia and atropin constitute the most important first aid in an injury. Every injured person should have morphia, and the atropin should be used with it. I believe there is no particular value in strychnia.

Another suggestion: An individual who is not shocked gets along very well if he does not get anything by the stomach; and in the case of an individual who is shocked, anything in the stomach is harmful. There is no absorption in the stomach under those conditions, and the material is not passed on. Two things you should carry with you: one, a fountain-syringe, which you can insert into the rectum and put in more water than in all day by the stomach; the other, a small needle that can be attached to the syringe in emergency cases, sterilized by boiling with iodin, shoved under the skin and 1,000 cc. of salt solution given, which is worth any amount of strychnia or any amount of strophanthin. If your case is very much shocked you can use strophanthin. But the alcohol, gloves, iodin, fountain syringe to give saline solution per rectum, and the needle to give subcutaneous injection, will not add to the burden of your patient.

Dr. Alfred M. Ridgway (Annandale, Minn.): In regard to the use of iodin applied locally as an antiseptic: I used the tincture frequently and freely previous to 1905, knowing that the tincture was not so strong as to cause any unpleasant after-effects. The tincture at that time contained 510 grains of the iodin crystals to the pint of alcohol. Iodin being so slightly soluble (about 1 part of iodin to 5,000 of water), it could not be used in aqueous solution without precipitating the iodin.

In 1905 the U. S. Pharmacopeia was revised and the tincture increased in strength and solubility. The present tincture contains iodin crystals, 542 grains, and potassium iodid, 387 grains, to one pint of alcohol. This tincture should never be used locally as an antiseptic until it has been diluted with alcohol from 50 to 75 per cent, as the tendency to blistering is so great.

DR. NYSTRUM (closing the discussion): There is one question I would like to ask Dr. Bloodgood, and that is, in sterilizing sheets and towels, lint, operating-gowns, and such things as are used in the country, wrapping them up in a sterile sheet and laying away for emergency cases, how long would he feel confident they would remain sterile in the ordinary country doctor's office? How long could we feel safe? I have seen doctors carrying these things in a sheet, and it seemed to me germs could go through that sheet.

DR. BLOODGOOD: I think I can answer that question by Pasteur's first experiment in bacteriology. He boiled milk in a test-tube, stopped it with a bit of cotton, and fifteen years after that milk was sterile. If you will take these dressings and wrap them in two sheets, one folded one way and the other the other, I believe they will remain sterile a lifetime. I am quite confident that in the work of any surgeon connected with even the best-managed railroad, if he would use his material enough it would be used up every two or three months, but there is no danger whatever when kept for longer periods if it is properly wrapped.

A very good plan in the matter of dressing is to introduce in your office work, as I am now introducing in the hospital, the application of simplicity and economy in surgery. You can take ordinary roll-cotton and put it in a candy paper bag, and make very small bundles that will carry a little cotton and a little gauze—I mean the small dressings for first aid. You can put a little larger one on top if you wish. Put them in sterile and let them dry out, and you have a first-aid package. This is a very economical way, and the manufactured gauze that you buy is much more expensive. Really, the technic of sterilization is very simple and can be done in your own office. A good sterilizing-apparatus can be procured for $10, and you can sterilize a great deal. It will come out wet from the steam in the sterilizer; place it on the table, and it will dry out, or, if in a hurry, put it in the oven and it will dry out quicker. It is convenient to have these sterile packages of gauze and cotton. It is a simple matter to keep it up, and I am quite confident there is no danger.

SYMPOSIUM ON CRANIAL INJURIES

THE MECHANISM OF FRACTURE OF THE SKULL

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In order to have a clear insight into fractures of the skull, it becomes necessary for us fully to appreciate the shape and character of the walls of the cranium, the amount and direction of the force applied, the size and surface of the inflicting instrument, whether the violence was applied directly or indirectly, and, if directly, was it at one point or at several? All of these conditions modify the kind of fracture, its position, and the direction of extension, and have been carefully studied by Wahl, von Bergmann, von Bruns and others.

The mechanism of fracture of the skull is totally different from that of fracture of any other bones of the body. This is due to the fact that both the individual bones and the skull, as a whole, possess a marked degree of elasticity, as well as having the required amount of rigidity and solidity to protect the contents from all ordinary degrees of violence. If you will consider for a moment the skull to be a hollow ball, made up of several pieces, each of which is more or less elastic in itself, we shall be able to make clear the action of force and show precisely what occurs when the head is injured, either by direct or indirect violence. If this ball is dropped upon a hard surface or is struck by an object, we get at once a change in its shape. The diameter in which the force

is applied is shortened, while all other diameters at right angles to this are lengthened; or, to repeat this in another way, we will say that the particles of the ball in the diameter in which the force acts are driven together, while those in all other diameters at right angles to this are forced apart.

You can readily see that if this force is but momentary and not too severe, we shall get a bending in of the portion of the ball that is struck, but, owing to its elasticity, it will immediately rebound to its former shape. On the other hand, if this force is strong enough to overcome the tensile strength and resistance to pressure, the portion which was struck must necessarily break at the point of impact. This break, which we call a "bending" fracture, occurs at the point of violence and is due to direct force. Let us see what might happen at a distance from the struck portion of our ball. We have said that the diameter in the direction of the blow is driven together, while other diameters at right angles to this are increased. Now, the diameters at the equator of our elastic ball are the largest and are forced apart or lengthened the most. If this forcing apart continues far enough, another break must occur at the equator, in one of the meridians connecting the poles, that is, the part which is struck and a point directly opposite it. This break would be in the nature of a burst and is called a "bursting" fracture, which always takes place at a point some distance from the site of impact.

The skull is not a perfect sphere like our imaginary ball, but the same physical laws hold good, and we get these two types,—the bending fracture at the point of violence and the bursting fracture at some distance. It has been found that the direction of the fracture bears a constant relationship to the direction of the force which produced it. Thus bending fractures run at right angles to the axis of compression, while burst-

ing fractures run parallel to this axis. This classification into bending and bursting fractures holds good for all forms of fracture of the skull. Of course, we often have a combination of these two, because we have seen that the injury which produces the one when carried far enough will produce the other. It likewise follows that a bursting fracture may occur in several of the meridians connecting the poles of the skull at the same time.

Now, let us analyze more closely these two kinds of fractures. The bending or compression fracture occurs at the vault or exposed convex portion of the head. It is due to a sharp impact against an object with a small surface. The result of this violence is materially influenced by the fact that the calvarium is not made up of one single sheet of bone, but consists of an outer and inner table separated by spongy bone called the diploë. This fact is of the greatest importance. Thus a blow, depending upon its severity, may produce three forms of injury. The first would be simply a bending in of the struck portion with no fracture and its immediate rebound to its normal position. This would merely produce local injury and is of no interest to us here. The second would be where the violence continues to bend in the skull until something has to give way. This something that would first give way is the inner table. The reason for this is the fact that the bending in not only causes a pressing together of the particles of bone forming the outer table, but also a stretching apart of the particles of the inner table. The cohesion of the particles in the inner table gives way first because it is less than the resistance to pressure of the particles forming the outer table. Thus a fracture of the inner table alone occurs when the force of the blow ceases here. This second-degree injury by direct violence is of the greatest importance to every practicing physician. We have seen several

cases of fracture of the inner table where no signs of injury to the outer one could be discerned.

Before leaving this point, let us repeat once more that fracture of the inner table without any apparent injury to the outside of the skull is of common occurrence, and, we are sorry to say, this fact is often overlooked in many cases of head injury. If the force still continues, there is not only a fracture of the inner table, but the resistance to pressure of the particles of bone in the outer table is overcome, and we get a complete fracture. In all of these complete fractures, the inner table, which gives way first, is always more extensively fractured than the outer sheet of bone, which is the last to break.

Suppose we consider the bursting fractures more in detail. We have shown that they occur from indirect violence in one or more of the meridians connecting the injured portion with a point directly opposite. They are usually produced when the skull is injured by a flat surface, although a comparatively small object which produces a complete bending fracture may also produce a bursting one if the force is sufficiently great. If the skull were a perfect sphere and of uniform thickness, the bursting would first occur at the equator, but this is not the case. The base is much less convex than the vertex, and is weakened by many foramina for the passage of various vessels and nerves. It is therefore the weakest part, and we find that bursting fractures occur here most commonly. After starting in one or more of the meridians these bursting fractures continue in this direction, but may deviate somewhat from this line. This is because the base varies in thickness, as well as having numerous openings in it which may deflect the course of the fracture. The general direction of the fracture, however continues, and this is of much importance because, knowing the direction of the acting force and position

of the impact, we can determine the course of a fissure through the base when symptoms of this lesion are present. For example, lateral compression of the skull produces a partial or complete transverse bursting fracture of the base, injury in the anteroposterior diameter gives rise to a partial or complete longitudinal fracture of the same kind, while in an oblique compression the fracture runs diagonally through the base.

These bursting fractures are not necessarily confined to the base, but may run up into the vertex or orbital plates. There is only a momentary displacement of the bone, as soon as the burst occurs the line of fracture gapes, but as the violence ceases the bones immediately resume their original position, and the fissure closes. During this brief opening and closing, the dura may be caught or foreign bodies from without such as hair, dirt or pieces of cloth may be, as it were, grabbed and pinched tightly between the bone or even inclosed within the cranium.

In concluding this paper upon the mechanics of fracture of the skull, we would emphasize the following:

1. The shape and elasticity of the skull are the chief guards against fractures.

2. When fracture takes place, it is either a compression fracture at the point of injury, a bursting fracture at some distant point, or a combination of both.

3. Compression often causes a solution of continuity of the inner table alone with no fracture of the outer shell at all.

4. Bursting fractures occur most commonly at the base because of its shape and weakness.

5. The direction of a fracture at the base may be judged by the direction of the blow and the position of the point of injury.

FOR DISCUSSION SEE PAGE 178

CONCUSSION, CONTUSION, AND COMPRESSION

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When considered from the standpoint of the railway surgeon, the subject of concussion, contusion, and compression, presents three of the most important conditions that he is called upon to diagnose, prognose and treat.

Concussion, contusion, and compression are so closely associated and so often complicated with each other and present so many symptoms in common that it is often difficult to determine just where true concussion ends and the symptoms of contusion begin; and likewise where symptoms of contusion end and those of compression begin. It might be said that these states overlap each other, or shade imperceptibly into each other, to such an extent that a positive diagnosis is impossible in the very beginning of a great many cases, and two illustrations will be given here to show how very guarded the surgeon must be in his early prognosis.

As the result of an automobile accident, two men were thrown forcibly for several feet both falling upon the head. Both were rendered immediately unconscious and presented every symptom of concussion. The first case appeared to be much more serious and was profoundly unconscious with deep, heavy breathing, resembling the deep sleep of a totally drunken man; he was bleeding from the nose, mouth and ears

and presented every symptom of fracture of the base with symptoms of contusion. After an hour or two he regained consciousness and continued to improve rapidly until the third day, when he got up and drove his automobile home without any assistance whatever.

The second or what appeared to be the less severe case of the two did not recover consciousness, as was expected, but remained in a stupor after a few hours, and the case was then considered one of contusion instead of concussion, as was at first supposed. He continued to grow rapidly worse and died in a short time with symptoms of compression. Autopsy revealed an extensive contusion of the base of the left frontal and tip of the left temporal lobes, also a laceration of the right frontal lobe with a large blood-clot.

The vault of the skull was intact in both of these cases and the case which seemed most serious soon recovered, while the one with apparent simple concussion soon proved fatal.

Traumatism is the sole cause of concussion and contusion. It is also a frquent cause of compression, as in depressed fractures of the skull, or by producing intracranial hemorrhage, intracranial edema or swelling of the brain within the closed skull.

However, compression is more often the result of other causes than traumatism, which may develop suddenly or gradually; *e. g.,* spontaneous hemorrhage or apoplexy, intracranial growths and abscesses which produce a localized effect similar to that of a foreign body; also intracranial edema resulting from meningeal inflammation, nephritis, etc., producing general compression within the cranial cavity.

Let these general considerations suffice for the present, and each condition will now be considered separately.

CONCUSSION

Concussion of the brain is a condition following

generalized injuries to the head in which no apparent lesion of the brain is present, but which presents symptoms of temporary impairment or abolition of the functions of the brain as a whole. (Johnson.)

To produce concussion there must be either the impact on the skull of a rapidly moving body, or of the skull in movement against a body; the suddenness of the impact is necessary to produce concussion. A slow crushing of the skull lacks entirely the characteristic cortical and bulbar signs of concussion. This is true of skulls that are crushed between railway coaches or under the wheels of heavy vehicles.

Koch and Filehne succeeded in producing the characteristic symptoms of concussion in animals by substituting, in place of the usual single heavy blow, a series of light blows frequently repeated, and as the blows were increased or decreased in force or frequency the characteristic symptoms were milder or more pronounced. The brains of these animals showed no macroscopic lesions, but microscopic changes were evident in every case.

Massland and Saltikoff, under the direction of Kocher, produced typical symptoms by suddenly applying different-sized weights upon a steel cylinder which rested upon the brain tissue, and they were able to produce the different grades of concussion through this trephine-opening.

A glance at the pathology confronts us with two different views or schools: The late von Bergmann and his followers believe that simple concussion may exist without any extravasation, while those agreeing with Kocher believe concussion is the result of minute contusions scattered throughout the brain as a result of the blow or blows.

The majority of authorities, including Keene, Bryant, and Buck, seem to hold with Kocher, that microscopic changes are constantly present. It is now

pretty generally conceded that, except in the very transient cases of concussion, there always exists a substratum of pathologic lesion. In the lighter cases there are degenerative changes in the glia and nerve-cells; in the more severe cases there is, in addition, widespread rupture of capillaries, with multiple minute hemorrhages. (Bryant and Buck.)

A third pathologic lesion is described by Hauser and others, namely, foci of softening without hemorrhage, dependent on swelling and degeneration of the axis-cylinders and medullary sheaths.

The above-mentioned lesions would tend to disprove the older theories of cerebral shock, but there are many who still advocate that a simple jar of the brain may so disturb the molecular integrity of the nerve-cells as to produce unconsciousness, or coma and death, and yet produce no lesion which can be recognized even by the microscope.

We shall here cite an experiment which seems to disprove the vibration theory: A trephine-opening was made in the skull and a small piece of paper with a needle mounted upon it placed in the brain mass; by delivering a blow upon the skull not the slightest vibration of the needle was observed; on the other hand the brain mass would bulge up momentarily into the trephine-opening and then sink back much beyond the normal position of the brain. This experiment has been repeatedly demonstrated and graphically recorded by Cannon, Horsley, and many others, and it brings out the following conclusions:

1. That the brain does not vibrate.

2. That the brain moves only as a whole and always moves in the line of violence and away from the point of violence.

3. That the brain receives two impacts from every blow; the first impact is received the moment the blow is struck as is evidenced by the momentary bulging of

the brain in the trephine-opening; the second is produced by the contrecoup effect of the brain being actually flung against the opposite side of the skull, and this is demonstrated by the brain receding beyond the normal limit immediately after bulging into the opening.

Experiments are unnecessary to demonstrate to us this propulsive movement of the brain, which produces the contrecoup lesions of contusions, which are evident to every brain surgeon and demonstrated at the autopsy.

This double impact produces a temporary anemia at the point of violence and also in the contrecoup area; the blood is actually squeezed out as a result of the blow and the propulsive movement of the brain against the opposite side, which temporarily interrupts the circulation. If the impact is more severe there are produced widespread microscopic contusions and extravasations of blood; these may also be macroscopic, with hemorrhages of varying size.

There is yet another movement besides this flinging or propulsive movement of the brain *in toto,* which occurs during a violent impact or blow upon the head. It is the so-called internal movement, which is produced by the sudden change in shape of the brain itself. This results in a disturbance of the delicate arrangement of the different parts composing the cerebral mass. The delicate network of glia and neurons, blood-vessels, cells, etc., is twisted and distorted extensively. The result is microscopic contusions and macroscopic hemorrhages.

It is very easy to understand the probability of the soft semisolid, or, as is often termed, semiliquid, brain being injured, distorted, or shocked from the effects of a violent impact upon the head or of the head against some obstacle.

We must not forget that the skull is decidedly elastic, and when a severe blow is received on the skull there is always a decided bulging or area of depression of the normal convexity. This bulging diminishes the available space of the cranial cavity. Were it not for the internal and external water-beds furnished by the cerebrospinal fluid with an escape toward the spinal canal, and the free exit of blood through the valveless cerebral veins, the injury to the brain from this flinging and squeezing effect would certainly be much more pronounced. This elastic bulging or area of depression occurs as a result of every severe blow whether the skull is fractured or not.

After much careful study and experimenting Kocher submits the following conclusions: That concussion is, in its essence, an acute compression of the brain, a squeezing or pinching, the results of which are (1) a momentary anemia, and (2) multiple, diffuse microscopic contusions; that the clinical phenomena are best explained by these two factors; and that it is always possible to demonstrate a pathologic lesion.

These minor pathologic lesions are caused by the sudden change in shape, the squeezing or distortion of the brain, following the change of shape or bulging of the skull from violent blows, the displacement of the cerebrospinal fluid, and the propulsion of the brain against the opposite side of the cranial cavity.

CONTUSION

Contusion of the brain, in its ordinary acceptation, indicates a bruising, with or without actual laceration, of the brain substance from whatever cause. (Bryant.)

It is considered by most writers as an advanced form of concussion; and, *vice versa*, concussion is a low form of contusion. The mechanism and pathology are practically the same as those of concussion,

except that the injury to the brain is more extensive, and the violence producing the same is more marked. The more severe forms are usually complicated by fractures of the skull, which are often compound. Contusion and laceration of the brain substance occur as a result of blows, falls, or gunshot or other wounds. It is always essential that direct or indirect violence be applied to the skull or the brain itself.

The violence may be direct, as in depressed fractures or punctured wounds of any kind, in which case there is an actual bruising of the brain substance, often combined with extensive tearing or destruction of tissue. However, the greatest number of contusions occur from indirect violence, and the mechanism which causes this form is the same as that described under concussion.

If the lesion occurs from direct violence, the chief injury is always at the point of greatest violence; especially is this true of perforating wounds. On the other hand, if the injury is due to indirect violence it is most often found in the contrecoup area; it may also be found at some point distant from the point of violence.

The lesions may vary from small hemorrhagic extravasations to destruction of a part of the brain, or even to disorganization of the entire organ; from small contusions and lacerations to extensive injury to the vessels and severe hemorrhage; more or less extensive tears through the brain tissue are found according to the violence of the force; actual bursting of the entire brain has been observed. Frequently lacerations exist without injury to the blood-vessels, but, usually, there is more or less injury to the vessels when a laceration exists. Laceration of the meninges is a frequent complication of fracture with hemorrhage into, between, and outside, the membranes.

Contusions, with or without laceration, are most apt to occur at the tips of the temporal lobe and base of the frontal lobes or at the point opposite to the point of external violence. (Contrecoup.)

Gunshot wounds occupy a class by themselves, as the bullet may make a clean perforation, or may become flattened and produce extensive destruction along its course.

An interesting case is described by P. Weismann which demonstrates in how destructive and yet how very peculiar a manner, modern firearms may act upon the skull and brain. A man shot himself through the head, in the temporal region, with a rifle. Death occurred instantly. The skull was completely burst asunder, the brain dislodged *in toto* and was lying several feet from the cadaver; and upon examination it was found to be almost uninjured. Two similar cases have been observed.

COMPRESSION

Compression of the brain is a condition characterized by an increase of intracranial tension.

It may occur either through the accession of some abnormal substance or through the abnormal accumulation of some substance already present. In fact, it may be due to anything which causes a sudden, continuous increase of tension. If this tension is localized or greater in any certain area, as in depressed fracture of a foreign body, it is termed *local* compression; if the pressure or tension is equable in all parts it is termed *general* compression.

In studying the mechanism and pathology we must take note of the following:

1. That after the closure of the fontanels the skull is a firm and unyielding cavity, which is incapable of being stretched or compressed, so that the space normally occupied by the brain, its membranes, and fluids, is fixed and unalterable.

2. That the brain tissue itself is as incompressible as water, but, since it is a vascular organ, it may be made smaller by having some of its blood squeezed out.

3. That with the exception of a small amount of cerebrospinal fluid, the brain and its vessels normally fill the cranial cavity.

It is apparent that any encroachment upon the space normally occupied by the brain will at once increase the intracranial tension, either locally or generally. This increased tension produces a sudden anemia of the brain tissue, by the blood being squeezed out under pressure greater than that in the cerebral vessels.

The first effect of any encroachment on the intracranial space is to drive out the small amount of cerebrospinal fluid normally present, unless the compression is due to an increase of the fluid itself. A further encroachment can occur only by crowding the blood out of the vessels, and since the pressure in the cerebral veins is lower than that of any other of the vessels, a venous stasis is produced, which is, therefore, one of the first consequences of pressure.

When this tension is increased so as to equal or exceed the pressure of the capillaries or even that of the arteries, then the result is pronounced cerebral anemia. If this anemia advances to the extent that the circulation is completely shut off for any considerable time, function in the parts thus deprived of blood is lost beyond recovery.

We must not fail always to bear in mind the difference between a local and general pressure, since the effects of a local tension are greater in its immediate locality and diminish with the distance from the seat of pressure.

As the falx and tentorium cerebelli form three compartments with considerable discontinuity between them, a local pressure in one may exist without seri-

ously affecting the others; but a compression equally distributed to all parts of the brain causes a general anemia and soon proves fatal, through anemia of the vital centers in the medulla.

These centers are of first importance, and a localized pressure in this region produces death just as rapidly as a general compression.

When the pressure in the medulla begins to equal the arterial tension, the anemia stimulates the vasomotor center, which, in turn, raises the general arterial tension. If the local pressure increases and again approaches the arterial pressure, the vasomotor center is again stimulated and the general tension is again raised. In this way the vital centers are kept sufficiently supplied with oxygenated blood to carry on their functions. This process may be often repeated until such time as the regulating mechanism is not efficient, and the blood-pressure drops permanently below the pressure exerted upon the centers of the medulla, when the respiratory center fails, and death ensues.

The arterial tension often does not remain stationary, but fluctuates above and below the pressure on the medulla, thus bringing about periodical cessations in the respirations, the so-called Cheyne-Stokes type.

This brings up the causes of the reductions in the intracranial space with resulting compression, which are as follows:

1. A reduction of the normal capacity. This may be due to changes in the shape or mass of the bony wall of the skull, itself either local or general.

2. An increase in the quantity of the cerebrospinal fluid as a result of edema, serous exudations, meningitis, nephritis, etc.

3. The entrance of foreign bodies into the skull, or anything acting as a foreign body, as depressed fracture.

4. Pathologic formation, such as extravasations, apoplexy, collections of pus, new growths in the brain itself or surrounding structures, etc.

The sudden contraction of the cranial space with resulting compression following head injuries is almost exclusively due to depressed fractures or extravasations from the resulting traumatism. We might also mention that as soon as the available space is reduced there is a displacement of the cerebrospinal fluid into the spinal canal, and the brain itself is displaced downward toward the canal, so that the medulla and cerebellum are pressed into the foramen magnum and may actually cork it up.

To summarize briefly: The phenomena of compression are directly caused by the circulatory disturbances, namely, the primary venous stasis followed by capillary anemia, and are not due to structural changes or mechanical excitation.

The anemia of the medulla is of vital importance and plays the chief rôle in the production of the so-called major or bulbar symptoms of compression. Life and death are dependent upon this factor.

SYMPTOMS

Concussion.—After the receipt of a blow or fall upon the head, the patient suddenly becomes unconscious and falls; the unconsciousness may last but a moment, or it may be prolonged many hours.

A slight blow may simply stun the individual, and he may recover immediately without any subsequent ill effects whatever. This is often described as "seeing stars," and is accompanied by flashes of light, ringing in the ears, momentary giddiness, and headache.

A more severe blow renders the patient helpless with momentary loss of consciousness. If it be a mild case, recovery begins at once; the patient regains consciousness, which is followed by weakness, dizzi-

ness, headache, dulness, and confusion, which may be present for some minutes or hours; and the accident itself is forgotten, as are also the occurrences immediately preceding the accident.

The serious cases bear a general resemblance to the slighter ones, but the unconsciousness is more profound and more sudden, and the duration is longer. It may last for minutes or hours, or even days, according to the severity of the injury. Shock is more pronounced; the face is pale and sunken; the surface cool and body-temperature low; the pulse slow and feeble; and respiration superficial, irregular, or stertorous. The reflexes may be gone, except the reaction to light and that of swallowing; the conjunctiva is insensitive, and the pupils are equal, normal, and contracted or dilated, but react to light; blood-pressure is below normal; vomiting frequent, and retention or incontinence of urine and feces is frequent. There may be convulsive twitchings of the limbs, and in rare cases the patient may become violent and have to be forcibly confined.

Contusion.—The symptoms are the same as those of concussion, except they are more pronounced and more persistent. The concussion fails to clear up, and symptoms of compression are very liable to appear.

External wounds may furnish valuable evidence of the nature and extent of the injury.

If laceration or destruction of brain-tissue exists, the symptoms may vary according to the location of the injury and the centers involved. Localized palsies may exist without symptoms of compression. (These localization symptoms will not be dealt with in this writing.)

Compression.—The phenomena will be considered under two groups:

1. Symptoms of irritation or stage of stimulation. Immediately after the accident the patient has headache and dizziness, and is irritable and excitable; sleep is interrupted and unnatural; delirium is frequent; the face is flushed; there is frequent nausea and vomiting; the pulse is slow and of high tension; and blood-pressure increased, and the pupils are equal and usually contracted. A very early sign is von Schultèn's eye-symptom, the veins radiating towards the optic disk being distended and tortuous, while the arteries may be narrowed. It is usually accompanied by a projection of the floor of the papilla in the fundus oculi or evidence of a beginning edema of the nerve-head. Von Schultèn's eye-symptom is present only at first and soon disappears. It must not be confounded with the choked disc, which appears later. The patient gradually becomes dull and more stupid and falls into a deep sleep, followed by pressure symptoms and coma.

This stage is sometimes completely masked by the symptoms of concussion or contusion, usually complicating this condition in all accident cases.

2. True pressure symptoms or stage of paralysis. Loss of consciousness develops into stupor and coma; there is stertorous and intermittent respiration; there is incontinence of urine and feces; at first the pulse is very slow, but later rapid and intermittent; the pupils become dilated; the one on the side of the injury is at first contracted and later dilated much more than the other; choked disc is present; there may be squint or slow rolling of the eye on account of involvement of the oculomotor nerve; when pressure has occurred suddenly there may be convulsive movements of the limbs; Cheyne-Stokes respiration develops; the face is cyanosed; paralyses also occur, which may be limited to a particular group of muscles or to one limb, or

may be in the form of hemiplegia or paraplegia; and the reflexes may be abolished.

As the fatal issue approaches, the pulse grows rapid and irregular; the compensation of the vasomotor mechanism fails and Cheyne-Stokes respiration becomes pronounced; the pupils are widely dilated; coma deepens; there is complete muscular relaxation; a permanent fall of blood-pressure occurs, and there is a cessation of all cerebral functions with a paralysis of the respiratory center.

DIFFERENTIAL DIAGNOSIS

When a case of head injury is seen immediately after the accident, it is usually impossible to prove whether the patient is suffering from concussion or contusion, or whether either or both of these conditions are complicated by compression.

A very slight case of concussion can be recognized by the mildness of the symptoms and the promptness of recovery. The sooner and more complete the return to consciousness, the more probable that it is simple concussion. If the unconsciousness is prolonged for hours or days, it is probable that contusion or laceration is present.

If a distinct interval occurs between the accident and the onset of typical symptoms it is diagnostic of pure compression, and this is usually due to intracranial hemorrhages. Such interval may be preceded by temporary loss of consciousness at the time of the accident. Immediate loss of consciousness is essential to concussion and contusion. The free interval and late appearance of symptoms speak for compression.

In concussion there is a general absence of eye symptoms, and the findings in the fundus are negative. The pupils react to light. The eye symptoms of compression are characteristic; one of the earliest is Schulten's eye-sign. This symptom is found very

soon after the accident; later we have the choked disc, unequal pupils, and wide dilatation of the pupil on the injured side; very sluggish reaction to light or no reaction whatever; slow rolling of the eyeball and squint occur; choked disc is constant in true pressure symptoms.

The pulse is slow in concussion and contusion, but lacks the high tension present in compression. The blood-pressure fluctuates in compression and is high at first, but later there is a permanent fall.

In compression we have characteristic Cheyne-Stokes respiration preceded by irregular breathing.

Lumbar puncture is a valuable method of differential diagnosis. In contusion or laceration the fluid obtained usually contains blood, while in concussion it does not; in compression the fluid is under high tension, and may or may not contain blood.

In pure concussion the reflexes are usually intact, and there are no localized focal signs. The latter appearing immediately speak for contusion, while appearing late they speak for compression. Thus a paralysis immediately after the accident is diagnostic of contusion or laceration, while one preceded by the distinct interval of consciousness is pathognomonic of compression.

The more widespread the paralysis, the more extensive is the underlying cause; *e. g.,* a widespread paralysis indicates a large hemorrhage. A limited paralysis indicates hemorrhage between the dura and the skull; a widespread paralysis, hemorrhage beneath the dura.

We might mention uremic coma, which is differentiated by the characteristic stupor, the findings in the urine, and an absence of the profound symptoms of concussion and compression.

Alcoholism may be excluded by the history of intoxication, the breath, and absence of the characteristic symptoms of concussion and compression.

Cases of poisoning can be eliminated by a history of the case, the characteristic symptoms of the drug used, and the absence of the symptoms of other conditions.

PROGNOSIS

This should always be extremely guarded. In a case of simple concussion with an early return to consciousness and no subsequent evidence, the prognosis is favorable.

The symptoms of concussion may persist indefinitely, and the headache, mental depression, etc., may remain a long time and even permanently.

In contusion the symptoms are more pronounced and more obstinate; the convalescence is likewise more protracted, and the patients are very liable to be troubled with headache, irritability, nervousness, and mental depression for a long time, if not permanently.

Death may occur immediately from concussion and is a very frequent result of contusion, laceration, etc. It is the usual result of a high degree of compression, unless operative procedures are promptly resorted to. Unless measures can be adopted to relieve the pressure the prognosis is bad.

In acute cases the prognosis hinges on the size of the compressing mass and the length of time it is effective.

Inequality and insensitiveness of the pupils indicate a serious condition with a high degree of tension; but if they are equal and react, a mild degree of compression is present.

A sudden fall of blood-pressure is a bad omen. Cheyne-Stokes respiration and abolishment of the reflexes is also unfavorable.

If the compression itself does not prove fatal, it is probable that it will be followed by paralysis, which may or may not prove fatal.

TREATMENT

In every case of injury where there is any doubt as to the exact lesion, it is always advisable to shave the head, and, if there is the slightest probability of a fracture that can not be definitely made out through the scalp, to make a free incision and examine the skull carefully.

Concussion.—Keep the patient quiet with the head low, the body warm and an ice-bag to the head; use artificial respiration if necessary. If the vasomotor mechanism is upset and the arterial tension failing, we should at once make an effort to restore the same by bandaging the extremeties or making pressure on the abdomen and by giving cardiac stimulants if necessary. Atropin is advised as the best drug; strychnin, digitalis, alcohol, and ergot are recommended, but their virtue is doubtful. Lumbar puncture is highly recommended to relieve the headache which follows; the ice-cap and morphia are also used for the headache and after-symptoms. Free evacuation of the bowels and continued rest in the recumbent position are necessary.

Contusion.—The same general treatment as just described likewise applies here. Rest in bed should be enforced until there is a complete cessation of headache, the pulse-rate becomes normal, and there is a complete disappearance of intracranial signs. In addition to the treatment described under concussion, urotropin in large doses is highly recommended, acting as an antiseptic and being eliminated into the cerebrospinal fluid.

Compression.—Treatment here involves two important steps: (1) removal of the cause, and (2) in-

crease of the available space. Surgical judgment is necessary to decide whether Nature will be able to accomplish these things alone, or an intervention will be necessary.

The large majority of compression cases are purely surgical. If a clot or depressed fracture is present it should be removed; the same is true of an accessible foreign body, an accessible tumor or abscess, or an excess of cerebrospinal fluid.

If the lesion is inaccessible the pressure should be relieved by opening the skull; and the same is true of irremovable causes. This brings about an increase of the available space. Lumbar puncture relieves the pressure of the cerebrospinal fluid, but it may prove rapidly fatal by the intracranial pressure forcing the medulla and the lips of the cerebellum down into the foramen magnum and wedging it there, causing anemia of the medulla.

Venesection is not considered with favor by surgeons in general. Urotropin should be given in large doses in every case.

Emergency measures consist of artificial respiration, bandaging the extremeties, pressure on the abdomen, and the infusion of normal saline solution. Cold to the head is useful, and the body must be kept warm. Surgical aid should be promptly rendered as soon as pressure symptoms are evident.

FOR DISCUSSION SEE PAGE 178

INJURIES OF CEREBRAL BLOOD-VESSELS

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Injuries to cerebral blood-vessels occur frequently in head injuries of all kinds. They may be produced from direct and transmitted force, or from two forces meeting each other. Solutions of continuity of cerebral blood-vessels from a railway surgeon's standpoint are caused from trauma, but may be favored by an abnormal condition of their walls, as, for instance, endarteritis, periarteritis, and aneurismal formation, causing vessels to be more friable and resistance to trauma thereby lessened.

We shall for convenience sake study these injuries under two subdivisions: extradural and intradural.

The extradural injuries are more often found to involve the middle meningeal artery and its branches, occasionally the sinuses and emissary veins may be the seat of injury. The anterior branch of the middle meningeal is most commonly injured, due, no doubt, to its superficial location and course, the bony vault being thin and more susceptible to external violence.

Symptoms found in extravasation between dura and cranial bones: Unconsciousness is complete; pulse is slow (often below 60); respiration is frequent and labored, and often stertorous; one or both pupils are dilated and do not respond to light, the pupil on the side of lesion usually being the one dilated. Owing to the location at or near fissure of Rolando, where we have the motor areas located, there is hemiplegia. If the compression is circumscribed the paralysis may be

confined to a certain group of muscles, as those of the arm, of the face, or of the eye. In hemorrhages from the anterior branch the clot will be located in the temporal region, extending to the base or over the side of the head; if the posterior branch is ruptured, the clot will be above the corresponding ear. It must be remembered that the vessel ruptured is not necessarily the one beneath the seat of the injury, because, not infrequently, the force is a transmitted one, and the vessel ruptured is upon the opposite side of the head.

If an injured person is first seen in an unconscious condition, and after a time the mental activities become restored and he does not lapse into a secondary stupor, the condition is no doubt due to concussion; but, if unconsciousness returns, it is conclusive that a hemorrhage is taking place. The lapse of time between the first period of unconsciousness and secondary period is called by nearly all authors the "free interval," and is considered one of the most important objective signs of extradural hemorrhages.

The focal symptoms are important in determining whether the extravasation is right- or left-sided. There are irritative signs shown by twitching of the face and hands, due to the usual situation of the hematoma over the lower end of the fissure of Rolando. Pupillary symptoms, particularly inequalities, are common in this form, as in other forms, of unilateral intracranial hemorrhages. The pressure of the clot is said to cause an early contraction of the pupil on the same side, and, later on, a dilatation. This dilatation may affect both pupils, but the one on the side of the lesion is more dilated than the other. Choked disc usually appears on the side of the lesion first and is considered a very valuable objective sign. These focal symptoms may be fleeting and may depend upon the rapidity of the formation of the hematoma. They are usually followed by symptoms of general pres-

sure, stupor and unconsciousness, slowed pulse, rise of blood-pressure, respiratory symptoms, and pressure symptoms of the medulla.

The absence of focal symptoms and the non-appearance of the free interval do not exclude the presence of an extradural hemorrhage, for, instead of finding a simple concussion, the injury may have caused a contusion with extravasation of blood, excluding the marked interval of improvement in cerebral symptoms. Furthermore, we may have no primary manifestations and later symptoms of extradural extravasation.

When typical symptoms arise, diagnosis is usually established without a great deal of difficulty, but when otherwise, an exploratory operation should be advised to confirm and reach a positive diagnosis.

Prognosis.—From the study of a large number of cases by Keene, Bryant, and Buck, it is estimated that 90 per cent die, if unrelieved surgically, 60 per cent of them dying within the first twenty-four hours. Of a large series 67 per cent recovered after operation. If prompt intervention were possible before medullary symptoms occur, a much greater percentage of recoveries would be possible.

When treatment of these patients is expectant they usually die, but when an operation can be resorted to they have a better chance for recovery. The trephine should be used, and used early, to get the best results. There are two objects to be accomplished by trephining,—evacuation of clots and hemostasis. It is a fortunate fact that, owing to the constant anatomic situation of the middle meningeal artery, the location of the effusion is fairly constant. Roughly speaking, the situation corresponds to the region from the external angular process in front to the auditory meatus behind, and from zygoma below to the parietal eminence above. An opening made in the middle of this

space under the belly of the temporal muscle will nearly always expose the clot, either at its middle or at its periphery. Perhaps it is not out of place to mention at this time something about the shape of the clots found. They are usually more or less circular; as the blood extravasates, it quickly clots, and the disc-like hematoma is constantly adding to its central point. On the other hand, when a typical form is seen it may be thick and circumscribed.

There remains the necessity of securing hemostasis after evacuation of the clot by endeavoring to ligate the branch of the artery. According to Vogt, a trephine placed a thumb's breadth behind the external angular process and two fingers' breadth above the zygoma will expose the anterior branch. Witherlie's point lies 1.5 inches behind the external angular process and one inch above the zygoma. Krönlein gives two points for trephining for the anterior and posterior branches respectively. The anterior branch will be found on Krönlein's upper horizontal line 1.2 to 1.6 inches behind the external angular process; and the posterior branch at the point of intersection of this line with the posterior vertical one, passing immediately behind the mastoid process.

Subdural hemorrhage is an effusion of blood in the free space between the dura and the arachnoid membranes. It occurs commonly as a complication of basal fractures on account of the close attachment of the basal dura. These injuries almost always tear this membrane, and then the bleeding from the fissured bone has free access to the subdural space. The same occurs in fractures of the vault, accompanied by lacerations of the dura, leading to extravasations over the hemispheres.

The usual type of extravasation is a diffuse one, particularly in the basal form. The blood spreads freely through the open subdural space, and as it often happens that the arachnoid overlying the basal

sinuses has been torn by the injury, the bleeding extends over the brain-stem and down along the cord, where the subarachnoid space is open, and not a close meshwork, as it is over the hemisphere. These extravasations are more often of venous origin than of arterial.

Symptoms of subdural hemorrhage differ in no great respect from those associated with an acute increase of intracranial tension from any cause. In the rarer cases of circumscribed and superficial clot-formation, there may be localized signs pointing to the seat of the effusion. The symptoms, however, are usually those of a generalized compression. At first, in slight injuries there are headache and some focal symptoms referable to the site of the lesion. Mental dullness, and later headache are more pronounced, with vertigo, restlessness, excitement, and delirium. Face cyanotic; bounding pulse; Cheyne-Stokes breathing; respiratory reflexes abolished; finally, evidence of cardiac failure; coma deepens; complete muscular relaxation; pupils widely dilated; fall of blood-pressure; cessation of all cerebral functions, with respiratory paralysis. Death ensues if not relieved by intervention.

Then, again, we have the cases without such a slow onset, but from the very time of a serious cranial injury the clinical picture is one of cerebral contusion with compression. The patient is unconscious, medullary symptoms present, blood-pressure high, slow pulse, respiration labored, stupor passing into coma, and finally, unless pressure is relieved, the paralytic stage of compression ensues.

In other cases, if the injury is not so severe, the extravasation is slight and not sufficient to produce serious pressure symptoms.

Diagnosis of subdural hemorrhage is not so difficult as that of extradural effusions, although, until an op-

eration has been performed or a lumbar puncture reveals blood in the subdural space, diagnosis of this injury is somewhat uncertain. Confusion may arise in certain cases, owing to similar symptoms of compression of the brain arising from the acute traumatic cerebral edema.

The lumbar puncture will clear up any doubt between the two. After performing the lumbar puncture, to confirm the doubtful diagnosis, one should proceed by collecting the fluid in three tubes. By this measure we distinguish between blood present in the cerebrospinal fluid and that from the accidental puncture of a vessel by the exploring-needle. In the latter instance the blood is apt to be pure, or nearly so, and only a few drops, which are found in the first tube, while in the second and third tubes is the cerebrospinal fluid. If bleeding has occurred into the intradural space in the cranium, and it is evacuated into the lumbar subdural space, the fluid will be uniformly tinged, and will be the same in all three tubes. The blood in the former case, due to puncture of the artery during the operation, will coagulate; while in the latter, being held in an isotonic solution, it does not coagulate. If the bleeding has been primarily into the extradural space, the blood will not appear in the puncture fluid unless the dura has been simultaneously torn, and the tinged cerebrospinal fluid will not be found upon the lumbar puncture. Where we have cerebral compression-symptoms, due to acute traumatic cerebral edema, this can be differentiated easily from the above by the lumbar puncture, as subdural hemorrhages are usually caused from basal fractures of the middle fossæ, while we invariably find blood appearing from the ears, nose, throat, and subconjunctival mucous membranes.

Treatment.—First, in the presence of a depressed fracture; next, in the presence of a condition which

indicates a localized compression from blood. If there are no symptoms indicating pressure transmitted to the bulbar centers, the question arises whether, in view of the possible absorption of the blood-clot, one should not wait for some days, rather than operate as soon as the diagnosis is agreed upon; in the former instance an operation should be performed as soon as possible. If symptoms of motor paralysis have not appeared in from twenty-four to forty-eight hours after the injury, but later than that above mentioned, it is quite possible there is some intracranial pressure, not so much by blood-clot as by a localized collection of serum or cerebrospinal fluid or a localized edema of the brain substance. The paralysis may disappear in a few days without operation.

When the symptoms have come on shortly after the injury and persist, it is important to trephine without delay, to prevent ill-effects on the nerve fibers from continued pressure, and to restore consciousness, by that means preventing inhalation pneumonia and at the same time precluding meningeal adhesions from organization of the clot and of gliosis in the cortex.

If symptoms of pressure on the medulla, in addition to those of localized pressure, appear, the indication to operate becomes absolute. The chief object, if a clot is causing the compression of the brain, is to remove the same, and, if free fluid is in the base, to open and relieve compression. The temporal region is the best site on account of its being easier to enter and is best protected. A route through the temporal muscle is most desirable, for the reason that the muscle helps to prevent a cerebral hernia and a possible fungus cerebri.

The usual method is by splitting the muscle, entering the skull low down at the side of the middle fossa, and opening the dura, allowing the withdrawal of as much of the bloody cerebrospinal fluid as possible. If

bleeding is continuous drainage should be introduced under the temporal, and led out through the intramuscular incision at its lowest angle. The remainder of the split muscle and the skin may be closed.

If the pressure symptoms are not relieved it may become necessary to perform a bilateral operation. In this way a number of these serious injuries may be relieved unless they have been allowed to approach the paralytic or terminal stage of compression, and laceration of the brain has not been too extreme.

REFERENCES:

Keen's System of Surgery.
American Practice of Surgery. Bryant and Buck.
Levings' Everyday Surgery.

FOR DISCUSSION SEE PAGE 178

SYMPTOMATOLOGY OF ORGANIC LESIONS AFFECTING SENSORIMOTOR AREAS

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As nearly everything I intended to include in my paper has already been gone over, there is no material occasion for taking time now; therefore I shall simply summarize a few things I had in mind to give you.

The amount of injury apparent on the head surface does not always indicate the amount of damage within. The person may have very little pain and no loss of consciousness, and yet have tremendous damage. And a case in your care which shows any disturbance of consciousness after any injury to the head, direct or indirect, should be watched closely for several days, for sometimes a case showing no apparent damage has been fatally injured. I remember a case in point, that of a woman who was thrown out of an automobile. The other members of the party had surface abrasions, but she did not think she was hurt at all. She sat out on the porch at the home of the village doctor who had charge, while he was dressing the wounds of the others, and when accompanying the party to the train the doctor spoke to her, thinking she did not look quite well, and telling her she had better wait. In three hours she was unconscious and in seven dead; yet she had walked on ahead, apparently having sustained no damage.

It would perhaps be well to take up first a little of the physiology of things, in order to get our groupings. You will recall that the sensorimotor areas are in the mid-region about the fissure of Rolando; on the left side is the speech center as well as the motor, the centers for the face, the upper extremity and the lower extremity located from below upward. In the region posterior to the fissure, including the inferior parietal lobule, is located general sensation, both muscle and tactile, and in the same immediate neighborhood the sense of location and also stereognosis. In this neighborhood the first temporal is located, the appreciation of things that are heard; in this, the angular gyrus, the appreciation of things that are seen.

Damage at various levels in the brain produces varying manifestations. When the injury is cortical, if on the left side, we usually have speech involvement in a measure. We have one, possibly two, rarely three, extremities involved, because on the surface it takes a very widely distributed area of damage to make a complete hemiplegic manifestation. When speech is involved, ordinarily the face or arm will also be involved, possibly the face and the arm together; if the injury is higher, the leg or the leg and the arm together. Not only is there loss of motion, but there may be slight involvement of sensation. The loss of motion is, however, rarely complete except in the early stage. In a case of head injury the degree of loss of consciousness varies from profound coma through moderate dulling of the sensorium and somnolence up to practically no disturbance at all. With continuation of the comatose state all the reflexes may be gone, all the muscles may be relaxed, and there may be apparently a general condition of paralysis. This may last for a day or two; in some cases over that, but not usually.

Then we find a given group of muscles partly paralyzed, a slight or sharp change in reflexes over a localized area. If all muscles remain relaxed or paralyzed for any great length of time the result is almost invariably fatal, and if you find this condition you are pretty certain of a fatal outcome. Ordinarily, however, the reflexes will come back, and the flaccidity changes to a spasticity in muscles that are going to be paralyzed for a great length of time or permanently. The occurrence of the Babinski reflex is characteristic in these cases. The other reflexes persist in exaggeration longer than does the Babinski, which usually fades out after a time. Therefore, when the ordinary reflexes are increased and the Babinski fades, this is a beautiful group-picture of injury either to the cord or brain, but somewhere through the neurons centrally or peripherally.

With injury to the cortex we also are likely to have a certain amount of twitching or convulsive manifestation, because of irritation of the cortical cells, and your grouping of surface injury is usually monoplegic. The loss of motion is only moderate after the first few hours, and the involvement of sensation is only slight in amount; rarely is sensation profoundly involved, and when so it is almost unfailingly hysterical and not organic. The occurrence also of twitching or of convulsive manifestation goes with your grouping, indicating injury of a surface vessel or cortical substance.

When the injury is deeper in the brain mass, in the corona radiata or down in the internal capsule, a smaller focus will give a larger area of symptom-complex; for instance, a ganglion cell with its center, its dendrites and axon, coming down, crossing in the medulla and going down on the opposite side, a peripheral ganglion cell in the anterior gray matter and the issue of the peripheral nerve to the muscle,

as the emergence, say, of the facial nerve to its muscular supply. We shall take up a little later the meaning of this nerve-distribution as related to the results of injury.

An injury in the centrum ovale, with the different fibres passing to and from the upper and lower extremity, will make a larger zone of damage, and in the internal capsule a very much larger zone of manifestation, with a smaller injury, because the entire group of sensorimotor fibres pass here. If the injury is in the anterior portion of the posterior limb of the internal capsule, we shall get motor loss and almost no disturbance of sensation; if situated farther back, it includes both and occasionally involves the thalamus. In these are rarely, if ever, any convulsive manifestations at all. The total manifestation is exactly limited because the central neuron alone is involved.

In regard to the divisions between the central and peripheral neurons: The central neuron originates in the cortical portion of the brain, and the next gray cell may be situated in the basal centers, or it may be down in the anterior horn of the spinal cord; therefore any injury in or above the basal ganglia invariably causes a central neuron paralysis, which is manifested on the opposite side. If the injury is lower, in the neighborhood of the pons anywhere, you may get a mixture of central neuron and peripheral neuron conditions, and you may get all sorts of crossing manifestations. We shall only speak of two: one is the face on one side and the body on the other, —the facial nerve on the left side and the body distribution on the right side, when you have, unfailingly, an injury at the base; that is, striking the facial nerve after it has crossed, and the peripheral distribution before it has crossed. With injury at the base you also get, at times, convulsive manifestations, so

when you have this picture you must not of necessity conclude that you have a cortical lesion.

There is one other form of crossed paralysis which may occur in head injuries, and that is sensory, in which the fifth nerve, situated in much the same neighborhood, may be involved on one side, and the body-distribution sensory on the other side. But that is a very rare condition in anything except tumors.

We have, then, summarized briefly the motor and sensory disturbances occurring in the different locations. The question of the involvement of special sense areas in damage also needs to be considered.

Referring to the post-central region, back of the fissure of Rolando. Injury here not only causes moderate involvement of tactile sense, but at times the individual cannot tell where the extremity is placed, that is, the sense of location of the limb is impaired. There is also loss of stereognosis if the focus is in the neighborhood between the ascending parietal and the inferior parietal lobules, the location of stereognosis, or the recognition of the thing the person is touching; he can feel the object, but can not tell what it is. If damage is in the first temporal convolution, the individual loses the perception of the thing heard: he hears the sound, his hearing is intact, but he is unable to grasp what he is hearing. This is word-deafness, or a form of sensory aphasia.

If the damage is in the angular gyrus, he is unable to recognize the thing he sees; he sees the object, but has no conception of it—the recognition of the thing he sees is lost, another form of sensory aphasia.

Amnesia is also quite common with any of these injuries; that is, loss of memory for the time extending over the period during which the accident occurred, and sometimes retrograde to that time, the patient not being able to recall incidents for hours or even days prior to the time of the injury.

Then we must take up the question of mentality in these disturbances. The person may be delirious at first or in the condition of semi-somnolence; if he has been addicted to alcohol he may have wild delirium. His mental condition may remain somewhat confused, and sometimes the cases that are going to be the most dangerous are those which at first are simply confused and hardly anything more. Those cases sometimes die within a few days. So, when you have nothing but a mixed mental picture of confusion, be on your guard, as with all others, or you may come to erroneous conclusions.

These mental disturbances may remain for a long time after the physical manifestations have cleared up, except that the reflexes are likely to remain exaggerated for some time and perhaps permanently. The mental disturbances may remain months or years.

I recall one case treated in the City Hospital at Minneapolis some years ago in which, after the initial conditions had passed, the patient was up and seemed to talk and act in about the normal manner and yet acted a little peculiar. I met that man afterwards, and he told me that for nearly a year after the accident he remembered hardly anything that occurred. Sometimes people remain mentally disturbed permanently, with a change in personality and temperament. I remember one man who went through a serious automobile accident, lying unconscious for a week. Before the accident he was a rather quiet, unobtrusive man, not much of a talker; after the accident he became somewhat aggressive and has remained different, being quick in temper and decidedly talkative and somewhat aggressive, which is a distinct change in his personality.

This, I believe, covers about all of the essential points in reference to injuries to the sensorimotor areas, including the sensorium itself, that I need take

up. Other features have already been touched upon or will be covered in the papers to come, except perhaps a word in reference to involvement of some of the cranial nerves at the base, which will probably be largely touched upon in the paper, "Differential Diagnosis of Fracture of Base of Skull"; but these nerves may be involved in damage to the brain without fracture.

The third nerve is not infrequently concerned in brain injuries, especially those occurring with hemorrhage or laceration at the base, as well as with fracture. When this does occur there is downward and outward rotation of one or both eyes, dropping of the eyelid, and, usually, the pupil on the side of the injury is dilated, but that is not constant. In any of these brain cases where we find both pupils wide open, dissolution is imminent.

The fourth cranial nerve is so seldom involved that it does not require mention.

The fifth nerve is not frequently involved, but when it is we have, of course, involvement of sensation on the side of the face, the muscles of mastication are involved, and not infrequently there is impairment of taste through involvement of the chorda tympani.

The facial nerve is frequently involved, the sixth sometimes included with it, in which case the eye is allowed to swing in, and, of course, in involvement of any of the muscles of the eye there is double vision. When the seventh is involved you have paralysis of the side of the face—you may have this alone or involvement with other cranial nerves, or you may have it involved with crossed paralysis on the other side of the body. If it is an injury high up in the geniculate ganglion you will have the soft palate disturbed also, as well as the musculature of the side of the face in general.

In regard to the eighth or auditory nerve: Involvement in fractures of the base is sometimes difficult to determine unless a complete test is made and loss of bone-conduction determined. It is hardly necessary to speak of the hypoglossal or glossopharyngeal nerves, as they are seldom involved in the ordinary case.

Keep all these patients under close observation and at rest; for many cases treated lightly or carelessly in the beginning have been fatal because not properly taken care of in the initial stage. You may prevent complications and save life by giving every case that has suffered any amount of direct or indirect violence to the head most careful attention. And do not always look for injury to the head itself. You may get fractures of the base or gross lesions of the brain, with bleeding, from falling upon the buttocks or heels. And so whenever you have any disturbance of consciousness or any sign or symptom giving the slightest reason to consider that the brain has been injured, treat the case with the utmost care at once.

FOR DISCUSSION SEE PAGE 178

OCULAR MANIFESTATIONS OF CRANIAL INJURIES WHEN THE OPTICUS IS NOT INJURED

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MINNEAPOLIS, MINNESOTA

I. MANIFESTATIONS IN THE TUNICS AND MEDIA OF THE EYEBALL

When the eyeball itself is not the direct recipient of violence, it may, nevertheless, present multiple and interesting disturbances after cranial injury.

Descemet's Membrane and Canal of Schlemm.—Peculiar disturbances in Descemet's membrane, with rupture of the canal of Schlemm, may occur, showing blood-pigment and atypical, whimsical, and multiform lesions of the cornea, from which keratitis has often been erroneously diagnosed.

Hemorrhage into the cornea does not occur without direct injury to the opticus; however, when a hemorrhage into the anterior chambers occurs, a small spot of blood may appear as thought it were in the cornea. Numerous cases of keratitis are reported after cranial injury where no direct injury to the cornea was supposed to be present. It is probable, however, that had careful examination, with sufficient light and magnification, been made, a foreign body would have been found, and later ulceration and hypopyon would have been avoided. Keratitis may result through the tortuous route of trophoneurotic disturbance, extreme malnutrition, or lagophthalmus.

Refractive Errors.—Myopia of two dioptres is reported by Szite after cranial injury. Hyperopia and hyperopic astigmatism has been observed, with or without pressure back of the eyeball. In such cases without pressure the anterior chamber is deepened.[1]

Hypema, Iridodonesis, and Hemorrhage.—Hypema, iridodonesis, and rupture of the zonula may occur, with or without dislocation of the lens.

Atrophy of Iris.—Late atrophy of the iris with change of color has often been observed after cranial injury. Hemorrhage and distortion of relations may occur in the uveal tract. Retinal hemorrhages are found with hyalitis and late optic retinitis.

Cataract.—Concussion cataract is very common and well known, and usually begins to appear from a few hours to a few days after the injury. Hemorrhage in various parts of the eyeball, as well as central cataract, may occur from lightning or from the passage of the commercial current through the body. Certain occupations, as those of glass-blowers and founders, especially predispose to cataract and lowered visual acuity. Coloring matter forms a protection to the body against the entrance of chemical rays. The lens and refractive media cannot contain coloring matter, hence this protection is denied to the visual axis of the eye. Cataracts produced by chemical rays are central and incomplete. In poor illumination, where the pupils become large, such cases will always see relatively better. (Pupillary day blindness—night sight.)

Choroidal Rupture.—Rupture or even multiple rupture, of the choroid has been observed after blows on the head without recognized fracture. Of course, resultant lesions from cranial injuries will be fewer in normal, healthy subjects. It requires no imagination to comprehend that those suffering from arterial change will be more liable to hemorrhages. Likewise,

tuberculous and luetic patients are predisposed to secondary inflammations. The same injury which would produce retinal detachment in an extreme myope, might leave unscathed an emmetrope.

Retinal Detachment.—Retinal detachment is one of the most common and troublesome lesions resulting from cranial violence. Hobb's disease of the macula may occur from violence or electrical phenomena. Rupture of the retina has been repeatedly recorded.

Embolism and Thrombosis.—Embolism and thrombosis of the central artery are possible, and here must be remembered, also, air embolism from caisson disease. Dazzling and neuroretinitis may follow snow-blindness, which, in turn, may be followed by atrophy.

Optic Atrophy.—Optic atrophy may follow intracranial pressure, hemorrhage into the optic sheath, pressure from hemorrhage on the nerve, circulatory lesions, as small aneurism or thickening of the internal carotid near the exit of optic nerve, infection, and localized meningitis, thrombotic processes, and softening of small areas with toxemia. The selective affinities of toxemia are at present past finding out. Circle of Willis' lesions may produce optic atrophy or hemiopia.

Choked Disc.—Optic neuritis has been differentiated by some writers as a toxicity lesion in contradistinction to choked disc as a pressure phenomenon. The writer's experience tends to the belief that any degree of optic neuritis or of choked disc may be a result of brain-pressure from abscess or tumor. There are, however, many causes of neuroretinitis that fail to become productive of choked disc.

Choked disc may result from hemorrhage inflammation, and descending neuritis (when the lesion exists along the course of the optic nerve itself), interference with the lumen of the superior cerebral vein, disintegration of the perivascular sheaths, occlusion

of one or more of the venous sinuses which result from vascular infections or neoplasms. (Basal meningitis without involvement of the lymphatic sheaths shows no choked disc.) Hemorrhage and growths of the cortex or cerebrum produce choked disc by pressure on the brain tissue and circulatory interference.[2]

Abscess of the temporosphenoidal lobe is not as productive of choked disc as abscess of the cerebellar region.

More meningitis or pus-formation is required for the production of choked disc in the cerebral than in the cerebellar region. In after-trauma tumor choked disc appears resultant to the pressure of the hydrocephalus.

Sub-tentorial abscess and quadrigeminal growths are very prolific of choked disc, by closure of the iter.

Lymph- or scar-stenosis occluding the foramen of Magendie or Luschka, may also cause the lesion. Interference of the secretion or natural cerebral outlet may be a cause. Dilatation of ventricles under external pressure may produce collapse of the veins in the brain substance, and failure of absorption of the cerebrospinal fluid results with hydrocephalus and choked disc.

Papilledema begins first in the eye having the least tension; as the edema increases the resistance at the papilla increases, otherwise the edema would stop. The proof of the papilla-pressure increase, is the atrophy of the nerve fibers, which follows infiltration. Tension does not increase pro rata with, or dependent on the swelling of the nerve. There is no increase in fluid in the subarachnoid space, owing to non-potency of the iter or foramen of Magendie.

With dilatation of the ventricles, the size of the brain increases, the cerebrospinal spaces diminish, and

intervening fluid is subjected to pressure and forced into the sheath of the optic nerve, and this plays a part also in brain compression.

Hemiopia.—Hemiopia as a result of brain injury may be produced by hemorrhage, inflammation, or trauma growth. It may result from pituitary lesion, as a pressure phenomenon or as a toxemia, much as optic atrophy. It may affect both temporal or both nasal fields, or one nasal and one temporal field together, or one nasal or one temporal field alone. The fibers of each optic tract pass to the occipital lobe forming the optic radiation and to the oculomotor nucleus. From the left optic tract fibers will pass to the left temporal field and the right nasal field, and fibres from the right optic tract will pass to the right temporal and the left nasal field, the crossing being at the chiasm. Homonymous hemiopia or homonymous defects in the field of vision will depend on lesions above the chiasm.

If there is loss of pupillary reflex when light is thrown upon the blinded portion of the retina (Wernicke's hemiopia-pupillary reaction) the break in the conductivity must lie below the spot where the fibers of the oculomotor light nucleus are given off.

If the pupillary reflex is intact the lesion must be in the external geniculate body, the internal capsule, or as high as the cortex of the brain itself. In temporal hemiopia the lesion is seated in the chiasm and affects the decussating fibres only, being in the middle of the chiasm or in its posterior or anterior angle. This frequently occurs as a result of enlargement of the hypophysis cerebri. Different combinations of hemiopia may result from pituitary pressure. Complete blindness of one eye must be referred to a lesion in front of the chiasm, provided the other eye retains good vision. In cases where the defects in both eyes are not symmetrically situated, the lesion must be in

front of the chiasm, because interruption on the farther side *must* result in the production of symmetrical defects in the field of vision.

We are considering here under hemiopia defects in the field of vision which occur from a break in continuity and where the ophthalmoscope reveals no fundus disease to account for such defects.

Hemiopia as here considered may not be complete, but may exist as a central or pericentral scotoma symmetrically placed in the visual field of each eye. In typical hemiopia the border may vary a little, leaving intact the macula lutea; hence with bilateral hemiopia a small central field representing the fovea may be left intact.

Visual Disturbances after Severe Hemorrhage.—Visual defects and blindness following severe hemorrhage arise from ischemia of the retina with degeneration of the ganglion cells. In mild cases Tiegler thought visual defects were due to contraction of the vessels from excitation of the vasomotor system. Horstman believed cases following epistaxis were due to descending neuritis. Zentmayer believes in multiple pathogenesis in these cases.[8]

Pupillary Manifestation: Mydriasis and Myosis.—Mydriasis may be spastic or paralytic. It may be binocular or monocular. Few symptoms are more surely indicative of "twilight and evening star and one sure call" than some form of anisicoria. Spastic mydriasis may result from a legion of sympathetic irritations. It is of interest in this paper when caused by cerebral irritation. Other causes noticed by the writer are slight superficial injuries to the neck, enlarged cervical or mediastinal glands, tumor of the mediastinum, fracture of the clavicle or scapula, slight blows on the eyeball, tenotomies, chorea, tic affecting the region of the shoulder, many infective fevers, arterial changes (cerebral), tertiary syphilis, and para-

syphilis, including tabes, paresis, and luetic arterial change, and the syphilitic neuroses, simple neurasthenia and neuroses, probably from toxemia, caries of the teeth, sinus infections, injury to or lesions of the orbit, disseminating sclerosis, and many diseases affecting metabolism, as diabetes, etc. It also occurs in the pathologic conditions and anomalies of the eye itself, *i. e.*, refractive errors, muscular insufficiencies, increased intra-ocular tension, glaucoma, etc. The eating of putrid meat and fish, as well as mild mydriatics, produce it.

Paralytic mydriasis results from hemorrhage, inflammatory pressure or growth affecting the nucleus or course of the third nerve, and from many of the causes enumerated under the head of spastic mydriasis.

The oculomotor nucleus lies below the aqueduct of Sylvius, and anterior to it is the Edinger-Westphal nucleus, which lately has been considered as the innervation of the inner muscles of the eyeball. Fibers of the oculomotor pass the tegmentum of the cerebral peduncle and reach the surface at the inner border of the floor of the peduncle. The fibers are so loosely united at the exit that paralysis of one or more of them may result from hemorrhage pressure. Hence, in injuries affecting the base, this relation must be considered when symptoms of nuclear paralysis are present. (The writer believes there is one pupillary reflex center in the oculomotor center, a discussion of which would be inserted had not some digression already been made from title latitude.) Reflex pupil-rigidity exists for years where all the present known nuclei are normal; *per contra,* reflex pupil rigidity had been absent where the whole of the corpora quadrigemina was diseased. The lesions causing reflex pupillary rigidity is probably in the cord; at least a small area near the median line and near the respiratory centers at the spinal end of the fourth ventricle is of great

importance to the light reflex of the pupil. Abolition of the pupil reflex in amaurosis is not paralytic mydriasis.

Myosis.—Spastic myosis is manifest in beginning meningitis and may be produced by myotics.

Paralytic myosis may result from paralysis of the cervical sympathetic or from tabes or paresis. Spinal myosis gives the pupil that reacts to accommodation and convergence, but does not respond to light (Argyll-Robertson). Paralysis of the cervical sympathetic may result from fracture of the clavicle, injury to the cervical portion of the cord, syringomyelia, cervical plexus neuritis, tuberculosis of the upper lung, scar, glandular enlargement, goiter, etc. It is interesting to note the warm and red condition of the part, soon after sympathetic paralysis, and later, the pallor and coldness, and the lack of perspiration. Partial ptosis may result with paralysis of the cervical sympathetic.

Anisicoria.—When anisicoria exists there is often question as to which is the pathologic eye. The eye giving the least response to light will be the answer. It has been repeatedly stated by most eminent authority, that anisicoria is *always* pathologic. It seems, however, that in the light of more recent observations we may assert that anisicoria from a spastic mydriasis is often functional, granting to the opposition that, where the lesion is a paralytic one, there is a pathologic condition. We must not forget that pupillary disturbances are common in rheumatic patients, or that paresis or paralysis of the accommodation or the external muscles, or even optic atrophy, may follow influenza, chronic alcoholism, herpes, tuberculosis, malaria, diphtheria, pyemia, and severe auto-intoxication. In cerebral abscess, mydriasis has often been observed, with or without diminution in the corneal reflex, oculomotor involvement, ptosis, divergent squint, and ex-

ophthalmus. Paralysis may occur as conjugate or isolated, paralysis of the abducens often giving example of the latter variety. Paralysis after traumatic neuroses seldom, if ever, occurs to the oculomotor nerve. Such cases reported are undoubtedly in error, some undemonstrated brain laceration having been present.

When reaction to light is interfered with by synechia, mydriatics, or paralysis due to tension, the consensual reaction to light in the other eye takes place.

The absence of the reaction to light can also be caused by an interruption in the course of the reflex arc. In these cases the pupil is either found to be perfectly immobile, or its reaction for accommodation and convergence is retained, while the reaction for light has disappeared. In the latter case the reflex arcs running from the optic nerve to the oculomotor light nuclei are interrupted, while the connections of the centers for the pupil (for accommodation and for convergence), which adjoin each other in the oculomotor nucleus, are undisturbed. This purely reflex iridoplegia is very frequent in tabes and progressive paresis, and is so rare in other nervous diseases that it furnishes an important diagnostic point with regard to the presence or absence of one of these two diseases. In these cases it is often associated with a marked contraction of the pupil (so-called "spinal myosis"), but is also found at times with a normally wide, or even with a dilated, pupil.

A distinction must be made between reflex and absolute iridoplegia. In the latter the pupil reacts neither to light nor to convergence and accommodation. This affection also is frequent in syphilis, tabes and paresis and may follow laceration of the brain.

"It also happens that the reaction of the pupil to light is present without there being any perception of light, when blindness exists, even though the examina-

tion of the eye gives negative results. These cases are very rare, occurring, for example, in uremic amaurosis, so that, under these circumstances, our first thought would be of simulation or of hysteria, and we would examine for these conditions first. Cases, however, do occur in which the reaction of the pupil to light is retained, although the eye is completely blind; and this may occur even when the blindness is evidently due to disease of the optic nerve itself." This can be explained only on the hypothesis that the fibers for the conduction of the light reflex have an independent light center other than the oculomotor nucleus.

II. MANIFESTATIONS NOT CONFINED TO THE TUNICS AND MEDIA OF THE EYEBALL.

Disturbances of Motion.—The symptoms of disturbances of motion are diplopia, vertigo, headache, anesthesias, hyperesthesias, and pseudokineses. The head is generally held with some inclination varying with the lesion. (Pseudokinesis, or the apparent motion of objects, is always that in which the muscle itself would naturally turn the eye.) Tests of muscular anomalies are too generally well-discussed to admit of consideration here.

Disturbance of motility may be divided into three classes:

1. Orbital lesions: injuries to the orbit from wounds or fracture of the orbital walls, scar-contraction, periosteal thickening, post-trauma growth, inflammation, or nutritive changes. These may give partial or complete paralysis of any or all the external ocular muscles.

2. Basal paralysis may come from solution of continuity of the nerve, hemorrhage into the nerve, pressure from hemorrhage, callus, infection, post-trauma growths, abscess, meningitis, edema, embolism, aneurism.

3. Nuclear or fascicular paralysis comes from most of the causes of basal paralysis, as well as from arterial change.[5]

The location of the lesion in the disturbances of mobility, is important. One observes carefully the integrity of the orbital contents the walls of the orbit, scars running to or into the orbit, the appearance and prominence of the eyeball, and nystagmus, if present. Nerve tissue itself is incompressible, and intracranial pressure must affect the circulatory system. Concussion with edema may give symptoms of compression. Lacerations are prone to affect the cortex, especially at the base, blood will be present in the subarachnoid, and nystagmus often develops. Whenever there is intracranial-space pressure, the cerebral circulation is affected, and there *is* compression. If the lesion is unilateral and near the orbit the choked disc is generally unilateral on the same side. In subtentorial abscess the choked disc is generally bilateral. Lesions involving one occipital lobe or the optic radiation may cause hemiopia; if both sides are involved blindness may result. Some very interesting phenomena in such cases are reported of laceration of the occipital lobes, where the color-field alone was distorted or reversed, or color-blindness produced. Lesions involving the corpora quadrigemina may reduce the visual acuity, cause nystagmus, and are prone to give ocular palsies. Where cerebellar lesion closes the exit for the cerebrospinal fluid, choked disc follows rapidly. Intracerebellar hemorrhage often gives nystagmus. Lesions of the pituitary body affect the fibers passing to the nasal side of each retina and give bitemporal hemiopia. Owing to its proximity to the chiasm, lesions of the pituitary body may give optic atrophy without choked disc. Bony callus and posttrauma growths that invade the middle fossa, especially from the sphenoidal cells, affect the oculomotor

nerve, when invading the cranial chamber, and simulate luetic disease.

In the observation of the orbit, to be looked for, are suggillation, edema of the lids, conjunctival ecchymosis, infection or phlegmon, nystagmus, orbital periostitis, disturbances of the pupil, and nutritional changes. Suggillation, edema of the lids, and ecchymosis of the conjunctiva are probably the most constant of all symptoms, and become apparent from a few moments to as late as some days after the injury. The fractures of the malar and superior maxilla and of the base, are productive of these symptoms late, after the injury. Hematoma is observed from a few hours to a few days after the injury, and is often the cause of simple exophthalmus. Traumatic exophthalmus is accompanied by protopses, pulsation, noises, and vertigo, and must be differentiated from tumor, Graves' disease, phlegmon, sinus mucocele, cellulitis, and osteoprotopses.

Exophthalmus.—Exophthalmus after cranial injury may be due to aneurism of the ophthalmic or carotid arteries or may result from arteriovenous aneurism of the internal carotid and the sinus cavernosus, by which the blood passes directly into the vein and pushes the eye forward. In pulsating exophthalmus the blood from the ophthalmic vein is not carried back into the circulation. This is because the internal carotid pressure, exerted through the sinus cavernosus, is too great. The ophthalmic vein is thus changed into a pulsating tumor artery, situated above and to the inner side of the eyeball. Hence in pulsating traumatic exophthalmus the displacement is down and out. Traumatism is often the exciting cause of this variety of exophthalmus when arterial change is present.

Late cases, occurring a month after the injury, are generally from a trauma tumor, as sarcoma, encephal-

ocele, etc. The advent of traumatic exophthalmus is marked by a violent and sudden onset of pain in the eye, rapid swelling of the lids and orbital tissue, protrusion of the eyeball, double vision, and ptosis. Synchronous with radial pulse is the orbital pulsation, which is subjective, as well as objective, but which generally lacks the systolic accentuation of the bruit observed in non-traumatic exophthalmus. The tension of the eyeball will gradually increase, as shown by the tonometer, the lid aperture become elongated, and, if the cornea is not watched, ulceration will follow. The anterior chamber becomes deep, the pupil large and fixed, and the iris turgescent. The fundus becomes edematous, the arteries small, the veins large and congested, and the vision may be good or bad, according to the involvement of the vitreous and the choking of the disc. If there is no uveal involvement, degeneration of the uveal tract generally ends the visual life. Complete external ophthalmoplegia is then present.

Traumatic Enophthalmus.—Traumatic enophthalmus may result after cranial injury from trophoneurotic disturbances following lesion to the nerve trunk or nerve centers. It may also be caused by the cicatrix of orbital periostitis, causing contraction of the connective tissue of the orbit and consequent absorption of the fat. These inflammatory processes extend to the capsule of Tenon, and even the globe itself may become more or less atrophic. Mechanical enophthalmus may be due to fracture of the orbital wall and resultant depression.

In the trophoneurotic type vision is entirely lost, and an unsightly enophthalmus persists through life.

Ptosis.—Where there has been sufficient violence to the levator to produce degenerative changes, or where the innervation has been involved, partial or complete ptosis may be evident. When ptosis results from hemorrhage it often subsides after absorption.

Hemorrhage of the optic sheath with edema of the fundus, is common and is followed in severe cases by descending optic neuritis, choking of the disc, and optic atrophy.

Periostitis and phlegmon of the orbit are prone to follow orbital fractures, especially in luetic and tuberculous patients, and following contractions are hard to differentiate from those following base fracture or brain lesion, unless we take into consideration the general symptoms occurring at the time of an injury, as hemorrhage from the ears, small pulse, shallow respiration, vomiting, and unconsciousness. When the case is seen late the mental condition may point to brain lesion by showing mental deficiency.

The lachrymal gland may sustain rupture, dislocation, or inflammation; or sarcoma of the gland may follow injury.

Supra-orbital injuries involving the supra-orbital nerve, which is a branch of the trigeminus, are sometimes followed by lowering of central vision and contraction of the field of vision. This is probably the same phenomenon as is manifest in caries of the teeth or intestinal toxemia. Hysterotraumatic blepharospasm is nearly always present in simulated amblyopia following supra-orbital injuries.

Of all the orbital fractures, fracture of the roof is by far the most serious. This is due to the close proximity of the brain and the extreme thinness of the bony plate; meningeal lacerations or hernias, with loss of brain substance, followed by infection (meningitis or encephalitis) are frequent after such injuries. Again, fractures of the roof extend back to the foramen and result in late atrophy by callus-pressure. Roof fractures are often followed by vertigo, delirium, vomiting, unconsciousness, hemiplegia or convulsions, which symptoms often precede brain inflammation.

Fractures of the outer wall generally radiate from marginal fractures or fractures of the zygoma, and give the best prognosis, unless they pass through the floor of the orbit. Fractures of the inner wall often show emphysema of the orbit, bleeding from the nose, and bone displacement. There is often co-existing saddle nose and ptosis. Prognosis in these fractures is generally good.

Fractures of the floor of the orbit occur after great violence and extend generally from the maxillary or malar bones. Loss of sensation to the cheek and infra-orbital region may be added to other symptoms of orbital injury in these cases. Fracture of the orbital wall from contre coup are of great activity. They result after much violence, and nearly always occur with basilar fractures.

Visual Areas.—An area around the calcarine fissure, located on the internal surface of the occipital lobe, incloses the visual sphere of the cortex.[6]

The cortex collects impulses and puts them in motion, and this motion extracts knowledge. This knowledge the cortex puts forth as motor activities. When the eyeball and nerve paths are at fault there is physical blindness. When the luminous-sensation area is at fault there is cortical blindness.

Psychic blindness is the loss of commemorative images of objects. Loss of power of reading characters is verbal blindness and is one form of aphasia. The physical image is received on the retina. The psychic image is also necessary, demanding the commemorative receptive apparatus. Loss of correlation of the several centers connecting with the visual spheres, particularly that of language, causes verbal blindness.

BIBLIOGRAPHY

1. Wurdemann: Injuries of the Eye.
2. Wood: Practical Med. Series, 1911, vol. iii.
3. Zentmayer: American Journal of Ophthalmology, 1912.
4. Fuchs: Archives of Ophthalmology, 1909.
5. Wurdemann: Annals of Ophthalmology, 1910.
6. Wurdemann: Op. cit.

FOR DISCUSSION SEE PAGE 178

DIFFERENTIAL DIAGNOSIS OF BASE FRACTURE

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Fractures of the base of the skull differ in some particulars from vertex fractures. The resulting phenomena of base fractures are very similar in many respects to those of vault fractures. There are important differences in their manner of causation and in the resulting injury to vital structures. Infection of the meninges and injury to vital centers are more frequently associated with basal fractures.

Base fractures occur frequently with head injuries. The relative frequency of base to that of vault fracture is estimated differently by different observers of large experience. Crandon states that in 1,436 fractured skulls 530 were base fractures. Cushing estimates that base fracture alone occurs in 50 per cent of skull fractures, and states further that 70 per cent of all vault fractures are complicated by base injury. Crandon's figures show that nearly 50 per cent of base fractures occurring from 1864 to 1906 had a fatal outcome.

The mechanism of base fracture has been treated by previous speakers. The different forms are many. The commonest is in, or through, the middle fossa in a transverse direction. Frequently, this is a continuation of a fissure starting in the vault and the result of a bursting or compression fracture. The base differs from the vault fracture in this respect, that there is not so frequently actual bone displacement.

There are some exceptions. Most cranial fractures result from falls on the head, and the point of impact is usually displaced over a large area. Blows over the occiput with an instrument like a hammer have been known to displace a piece of bone inward into the posterior fossa. Further, base fracture resulting from blows on the chin has been shown to cause bony displacement in the anterior fossa. The structures around the middle fossa are so numerous and of such vital importance that fractures with marked bone displacement through this region are so rapidly fatal their consideration belongs only in the post-mortem room. Orbital punctured wounds need special care and observation.

The train of symptoms resulting from base fracture is similar in a general way to that of the vault. An error which is frequently made, is that of mistaking base fracture in the stage of compression for alcoholism. Intoxication was present in 30 per cent of Crandon's tabulated cases. It is dangerous practice to pass upon any case, however, that we find in a comatose stage as purely alcoholic because we find evidences of alcoholism, without making a thorough examination.

Apoplexy must be considered, and it is easily conceivable how a person in the period of life which is subject to cerebral hemorrhage, can fall and sustain a fracture. The diagnosis in some cases may offer difficulties in the absence of definite signs of injury. The high blood-pressure is common to both conditions. The method of lumbar puncture will clear up, in most instances, any questions arising in this group of cases.

Symptoms resulting from base fracture, or from any head injury, for that matter, correspond closely in most cases; *i. e.,* they show evidences of concussion, contusion, and compression to degrees which

vary widely. There are frequent exceptions to this general rule. Cases have been reported where patients walked immediately after the skull was compressed to a degree resulting in fracture passing entirely through the middle fossa, and still no sign of concussion showed until the threatening signs of compression appeared. Furthermore, it must be remembered that injuries with extensive laceration of cranial contents can take place without any cranial fracture.

GENERAL SYMPTOMS

General symptoms depend upon the degree of injury to the intracranial contents. We have the phenomena from concussion to compression with or without the lucid interval. There is a characteristic cyanosis of the face due to the disturbance in the intracranial circulation. We may have this in any form of serious cranial injury, but in a comatose patient with a history of injury and the absence of signs of vault fracture, it speaks strongly for base fracture.

The temperature in basal injury while similar to that of vault injuries, in the grave cases shows a high rise in a few hours after the subnormal temperature associated with shock and concussion has disappeared. Rawling considers this temperature-curve typical and particularly significant in base fracture.

Consciousness.—That is, as a rule, disturbed. There may be all degrees, from a transitory dizziness to sudden coma from which the patient never awakens. Many cases with mild initial symptoms have been known to pass rapidly into a fatal compression stage. The presence or absence of consciousness can give us very little of diagnostic or prognostic importance in the early stages.

Blood-Pressure.—The blood-pressure frequently observed after head injuries often gives a very good idea of what is going on. All cases first show an initial

drop; that is, in the stage of concussion and shock. A rapid and high rise takes place with compression. Such a rise in blood-pressure gives us positive indication for intervention in the absence of other signs. The observations of Cushing are particularly interesting in this connection.

LOCAL SIGNS

Hemorrhages.—Hemorrhages appearing at characteristic points, like the ears, nose, pharynx and orbit, when present and carefully interpreted, speak strongly for the presence of base fracture. At the same time these signs are so characteristic that their absence by no means excludes fracture. Hemorrhage from one or both ears occurs frequently with middle-fossa fracture if the petrous portion of the temporal bone is involved. Care must be used in excluding hemorrhage having its source in the external auditory canal. Likewise, in hemorrhage into the nose and pharynx, local sources must be excluded. Subconjunctival hemorrhages occur in so many other conditions that their interpretation needs care. Hemorrhage into these regions is more continuous and, as a rule, does not appear suddenly in cases of fracture. Hemorrhage or ecchymosis at the top of one or both mastoids has been given a great deal of importance as a diagnostic sign of posterior-fossa fracture, especially if showing up after twenty-four hours. This sign has been noted especially when fracture has resulted from blows transmitted to the base of the skull through the spine from falling on the feet. The important point in the interpretation of these localized hemorrhages is their persistence.

Escape of Cerebrospinal Fluid.—This sign is considered especially characteristic, but, like all signs, needs care in its interpretation. Rules for the chemical differentiation of this fluid from other secretions are not reliable for clinical purposes in this class of

cases as the important chemical differences of the cerebrospinal fluid must, of necessity, be obscured under such circumstances. The amount escaping has been found to vary widely according to different observers, namely, from a few ounces to three pints in five hours. This fluid, as a rule, does not appear immediately, and is known to continue for several days. The appearance of the cerebrospinal fluid or hemorrhages in these different localities does not give us any definite information regarding the extent or the severity of the lesion. Pharyngeal hemorrhage, according to Crandon's own observation, is a sign of grave prognosis.

Paralysis.—Paralysis of the cranial nerves is frequent in base fracture. The one most commonly observed is that of the facial, due to the frequent involvement of the petrous portion of the temporal bone in the middle-fossa fractures. One must remember that this may also be associated with injury to the motor area on the opposite side. Injury to other nerves also occurs, but the demonstration of its presence in many cases, like olfactory and auditory, depends upon the clear intellect of the patient.

The condition of the pupils gives valuable evidence of cranial injuries, but no positive indications as to the location of the injury can be derived from this source. Immobility of both pupils, especially when contracted, is a sign of grave injury.

Dr. Wright has handled the subject of choked disc in such an able manner that I shall not presume to discuss this phase farther than to call your attention to the value of the services of an ophthalmoscopic examination in doubtful cases. Anyone reading Cushing's observations will not doubt that compression is the important factor in producing this symptom.

Lumbar Puncture.—This is the symptom which will give us more definite information regarding the ab-

sence or presence of fracture than any other in doubtful cases. The dura is so adherent to the bone at the base that fracture seldom takes place without rupture of the same. Red-blood cells micro- or macro-scopically offers strong evidence of base fractures. Its method of performance is easy, and it gives us definite information as to the absence or presence of intracranial injury, and, in addition, can be of distinct therapeutic benefit.

Like all other signs, one must not place absolute reliance on this alone. Cushing reports a case where a base fracture resulted from compression of the skull. This was found on operation, which was performed when threatening compression symptoms ensued. The patient showed no sign of concussion, but subsequent events showed a fracture going across the middle fossa with a large extradural hematoma involving the base without rupture of the dura.

The cerebrospinal fluid has showed microscopic red-blood cells in the few cases that the writer has had the opportunity to examine since he learned to avail himself of this method.

I shall cite two cases illustrating the necessity of prognosis in any injury of the head.

CASE 1. A carpenter fell from a scaffold a distance of thirteen feet, striking his head on the ice. He was picked up unconscious, but in the course of a few hours he regained his full senses. No external signs of injury could be found. No bleeding, except slight immediate hemorrhage from the nose. Lumbar puncture showed microscopic blood. On the third day meningitis symptoms appeared, with rapid development and with sudden high temperature after the patient had been in an apparently normal condition for thirty-six hours. He died on the fifth day. Autopsy was not permitted.

CASE 2. Boy of 16 injured by a pitchfork tine penetrating the eyeball. The eye was enucleated and no signs of bone injury could be discovered. The patient died on the third day with all the signs of a culminating meningitis.

CONCLUSIONS.

The probability of base fracture can be fairly well established by classic symptoms. There is no one which will give absolutely positive evidence. Of all signs, lumbar puncture gives us the most important diagnostic data in cases where others are not conclusive.

Intracranial injuries presenting a serious train of symptoms which simulate base fracture, may be present without fracture. The extent and result of the fracture, with its attending symptoms, depend entirely upon the extent of injury to the intracranial contents.

FOR DISCUSSION SEE PAGE 178

THE TECHNIC OF INTRACRANIAL OPERATIONS

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The subject on which I am to speak is one so large that I considered it an impossibility properly to handle in the short time at my disposal today. I judged it wiser, therefore, to limit myself to the most important part of this large field, namely, to that operative procedure to which we most frequently have recourse in intracranial lesions, and which, because of its flexibility, allows the widest range for operative treatment.

I shall, therefore, in this paper, discuss only craniectomy as done for exploration and decompression, and I shall accordingly leave untreated all those numerous other procedures for decompression, some of which in certain instances are distinctly superior to craniectomy. The procedures which I shall not discuss are the sellar decompression of Arthur Schueller, and his puncture of the third ventricle by the nasal route; Anton's puncture of the corpus vallosum, the so-called *"Balkenstick"*; simple ventricular puncture, with or without permanent drainage of the lateral ventricles; spinal puncture and drainage of the spinal subdural space. All these procedures have been recommended for the reduction of increased intracranial pressure, and each has its own field, but the time at my disposal is too brief to do them justice.

Neither shall I discuss the treatment of hypophysis tumor and other lesions in the vicinity of the hypophy-

sis, which constitutes a most interesting chapter of brain surgery, but which cannot be handled properly except *in extenso*. I shall therefore confine myself to a discussion of the subject of craniectomy in my own experience.

Indications.—Since every operative procedure on the cranial vault has exploration more or less directly as its aim, and since, where exploration fails to detect the disease, decompression relieves the symptoms, we find this particular operation the most frequently employed and the most important in our work. With it may be combined brain puncture, removal of tumor, drainage of abscess, removal of blood-clots, the control of hemorrhage, and drainage of the ventricles. Therefore, together with its modifications, it includes nearly the entire field of cerebral surgery.

The conditions for which it is commonly done are the following: (1) tumor cerebri, localizable and not localizable, and particularly when associated with choked disc and pressure symptoms; (2) brain abscess; (3) intracranial hemorrhage; (4) craniostenosis, particularly tower skull; and, (5) more rarely hydrocephalus, unless associated with brain tumor (usually brain puncture is done here in preference to craniectomy); (6) brain syphilis, which does not yield readily to specific treatment; (7) encephalitis in some cases when associated with increased tension and causing optic neuritis or choked disc; (8) edema of the brain in uremia has been considered as an indication by Cushing*, but is a doubtful one; (9) in general, any condition associated with increased intracranial pressure and swelling of the optic disc demands for the relief of pressure symptoms and optic nerve changes, an exploratory operation, which may be later

*Cushing and Bordley: "Subtemporal Decompression in a Case of Chronic Nephritis with Uremia." Am. Jour. Med. Sc., October, 1908, pp. 484-504.

turned into a remedial operation, the character of which will depend on whatever pathologic condition may be found; or into a decompressive or palliative operation if nothing accessible be found.

Preparation for Operation.—In our clinic on the day before the operation the patient's head (whole head, if a man; something less than half a head, if a woman) is shaved, scrubbed with tincture of green soap on gauze, rinsed with sterile water, then with alcohol, and next with 1:1,000 bichlorid. A dry dressing is then applied. This scrubbing is again repeated on the table just before the operation.

A double layer of gauze, either dry or wet and wrung out of a solution of 1:1,000 bichlorid, is then applied to the entire cranium and over this the rubber constrictor. As rubber constrictor, we use an india-rubber band, 1 inch wide and 8 inches in circumference, which can be obtained of any house handling rubber goods. We make two or three turns with it around the head, which we find is constriction enough. There is no buckle to fasten; it never slips; so that tapes, as used by Cushing, are unnecessary, and the cost is only a few cents. The patient is then ready for the initial incision.

Anesthesia.—Before the patient is brought to the operating-room, he is given a hypodermic of morphin, gr. ¼; atropin, gr. $\frac{1}{100}$, or if the patient be small, or a woman, ⅙ and $\frac{1}{150}$ gr., respectively.

Ether, by the drop method, is, as a rule, the anesthetic of the entire operation; but in some cases, especially when for one reason or another speed is necessary, the anesthetic is started with nitrous oxid and oxygen.

Position of the Patient.—For temporal and motor area operations and in general for all operations on the anterior half of the cranium, the patient lies on his back, with head and shoulders raised, and anesthesia

is administered as for other operations about the head and neck. The operator and his assistants are, however separated from the anesthetist by the laparotomy sheet, which is held up between the field of the operation and the field of the anesthetist by an outrigger attached to the table.

For suboccipital operations and frequently for other operations on the posterior half of the cranium, the anesthetic is given and the operation performed with the patient lying on his face, the forehead supported on a headrest in the form of a bracket attached to the head end of the table, with sand-bags under each shoulder. These elevate the chest from the table, permitting relatively unrestrained breathing.

The anesthetist sits on a low stool and is covered by the laparotomy sheet drawn over the patient's head. The anesthetist, for his own comfort, wears a rubber cap and a rubber apron, closely tied about his neck, to protect his clothing.

We do not believe in further incommoding our anesthetist with a phonendoscope, as recommended by H. Cushing*, unless it be impossible to secure another assistant especially for the purpose of watching the pulse and respiration. The extra assistant is easily obtained in any large hospital, and the anesthetist has his hands fully occupied, and is in discomfort enough without being put to this extra inconvenience.

Occasionally, the Matas apparatus is used. Air saturated with chloroform vapor is led into the patient's retronasal space by means of a rubber catheter, introduced through the nose. When this apparatus is used the patient is put to sleep by the usual mask method, and just before the operator is ready to begin the nasal catheter is inserted and the anesthetic continued with the apparatus. The anesthetist is thus

*Cushing: "Some Principles of Cerebral Surgery," Jour. of the A. M. A., Jan. 16, 1909, p. 187.

completely removed from the field of operation. As only a relatively small amount of anesthetic can be administered by this method, it is usually desirable to use chloroform instead of ether, especially with large and fat patients and in alcoholics.

The incision is usually marked out on the scalp with iodin just before the double layer of gauze and the tourniquet are applied, so that the still wet iodin stains through the gauze. In locating the incision, measurements are usually dispensed with. The eye of the surgeon, who is constantly employed in cranial work, becomes as accurate as any of the craniometers on the market, and it is, moreover, always easy to enlarge the opening in any direction subsequently desired.

The incision is semicircular, to form a flap with the base in the direction of the blood-supply. The first cut is made down to the lamina externa.

At this point there is always some little hemorrhage from the vessels of the galea. This is usually easily controlled by (1) promptly turning the flap back and exerting pressure on it, providing that an osteoplastic operation is not to be done; (2) by catching and twisting with sharp Kocher forceps or ligating the "spurters" with fine No. 1 catgut; (3) by pressure by an assistant with gauze along the margins of the incision. If the rubber tourniquet can be used, the hemorrhage is insignificant.

We have never found it necessary to use the other measures sometimes recommended for stopping this hemorrhage, and we believe that in this we are sustained by the best American practice.

The running stitch of Jacob Frank, of Chicago, later modified by Heidenhain, and known abroad by the latter's name, would be useful, but is scarcely necessary, even though the tourniquet be not used, as, for example, in suboccipital and subtemporal decompressions. To keep these stitches in place for eight to ten

days, as Heidenhain recommends, seems to us, not only unnecessary, but even dangerous to the health of the flaps, and certainly predisposes to slow healing of the wound, and therefore to frequent loss of cerebrospinal fluid.

Kredel's plates we have even less use for than Frank's ingenious stitch.

Attacking the Bone.—If an osteoplastic resection is to be made, we proceed at once to bore through the skull. If merely a decompression is desired, we first strip back the periosteum with the skin flap.

Bone-Instruments.—We believe we have tried them all and have come back to the trephine or Hudson burr, supplemented by the De Vilbiss forceps.

All electric-driven machinery we have discarded,—burrs, drills, rotary saws, etc., etc. They are all wrong in principle because they open the skull from without inwards, and therefore expose the brain to injury from excessive penetration and bone splinters. They are all liable to slip at times, even in the hands of the most experienced men, as our dental colleagues can testify and cut undesired gashes in the bone and scalp. Moreover, their greater speed is largely offset by their liability to get out of order, thus causing long delays, and leading to faulty asepsis. Again, it is impossible to sterilize them *in toto;* and therefore slipping towels in the course of long operations are apt to leave nonsterile parts exposed to the surgeon's touch.

The mallet and chisel we have almost discarded because (1) of the time consumed in entering the skull, and (2) for the reason that we believe the repetition of blows upon the skull may possibly, as claimed by many, produce cerebral concussion.

We have been very well pleased with the Hudson burr. Its chief value is not in the rapidity with which it can be operated, but in its mechanical construction, which is so adjusted that when the teeth of the burr

strike non-resisting dura they cease to cut, thus making injury to the dura and underlying brain impossible, even when considerable manual force is applied.

The trephine opening is made large enough to admit a De Vilbiss cutting forceps, and with the latter the bone incision is enlarged in the direction of and parallel to the skin incision, or as desired, but keeping well inside the latter, in order to avoid overlapping of the bone and galea incisions.

If an osteoplastic flap is to be made, the bone incisions are continued around to the narrow base of the flap, which is then broken across by prying the flap with a bone-elevator and perhaps also making cuts at the sides with a special chisel.

Where an especially accurate reposition of the flap with avoidance of pressure on the dura is desired, a Gigli saw may be passed from one trephine opening to other and the intervening bone sawed through on a bevel.

A Braatz sound or similar dural separator and protector must be passed between dura and lamina interna and along this, as a guide, the Gigli saw is passed and manipulated.

We seldom use the Gigli saw method, because of the ever-present danger of damage to blood-vessels and brain in passing the sound and saw, and in making the first few strokes. The method also has the disadvantage of being somewhat slow.

When it is desirable to enlarge the bony opening, a new flap may be made with the De Vilbiss forceps, or bone may simply be bitten away in the desired direction with the Macewen rongeur forceps.

Hemorrhage from the bone has now to be controlled, and this is done by (1) pressure made by gauze packed tightly against the bone; (2) packing the oozing bone with Horsley's wax or with muscle tissue from the cut galea; (3) acupuncture with any pointed

instrument and mallet (a simple orange stick is cheap, easily sterilized and applied, and is usually at hand); (4) crushing of the bleeding bone with the rongeur forceps, which is usually successful if other methods fail.

The best way to avoid hemorrhage from large vessels in the diploe or on the inner surface of the inner table is to take a careful *x*-ray picture in every case. Then large vessels in the bone can almost always be seen and therefore avoided later at the operation. This is such an important point that it will be dwelt upon subsequently.

Hemorrhage from the dura and cerebrum occurs only when these are wounded, a rare occurrence with our technic. Occasionally a vein runs from the dura into the lamina interna of the cranial vault, and this may be cut through in the incision, but the resulting hemorrhage is readily controlled by ligating the vein on the dural side.

The dura now lies exposed before our eyes. By palpation with the finger-tips we estimate its tension, and by observation whether or not pulsation is present.

Where tension is much increased, active pulsation is usually absent. (This depends upon the relation of the intracranial tension to the blood-pressure.)

We must also feel for any increase in local resistance, such as would indicate a tumor or an infiltrate, and for signs of fluctuation, due to intracranial fluid or cyst formation.

The incision in the dura is next made. This may be either (a) cross-shaped or (b) a flap, the pedicle of which is placed either in the direction toward which further exploration is to be done, or in the opposite direction from that of the skin flap. Overlapping of the two flaps on closure of the wound is to be desired,

thus preventing a brain prolapse and subsequent fungus cerebri.

When the pia-arachnoid lies exposed, a careful examination is again made. Pulsation is looked for; dilated blood-vessels are duly noted, as an indication of an adjacent tumor; likewise differences in color, prominence, and smoothness of the surface. Any local tendency to obliteration of the sulci or flattening of the convolutions is regarded as an important localizing point. Palpation with the finger-tips of both hands is done to determine possible spots of increased resistance or fluctuation.

Exploratory puncture is then made into suspected areas and the tissue brought away by the needle is examined macroscopically and at times microscopically, to determine the presence of fluid, pus, or tumor tissue. The search for brain-tissue cylinders by needle puncture, as recommended by Krause we have found of not much value, and believe it to be dangerous.

Fenger, of Chicago, some years ago gave this method a considerable trial and invented a special needle for it, provided on one side with a slot with sharp edges. The needle was inserted into the brain, then turned around, thus cutting out a cylinder of tissue. Fenger finally abandoned the procedure, owing to its dangers and unreliability.

Exploratory Puncture for Pus.—We never make this puncture through the dura, but only after the membrane has been opened and the subdural space walled off by packing with several layers of iodoform gauze. When this is done, the needle is inserted, and, as soon as the pus pocket is located, an artery forceps is inserted along the side of the needle into the cavity. The blades of the forceps are then spread as they are withdrawn, and thus a large opening is made, with probably less damage to nerve fibers and blood-vessels than when a knife-blade is used. The cavity

is then irrigated, usually with normal salt solution, and packed with iodoform gauze. During all these manipulations the subdural space is kept well walled off with the iodoform gauze, the outer layers of which are renewed when the irrigation is complete. Drainage to the exterior is then made by a knife thrust through the galea flap directly over the opening to the abscess cavity, and here the drain, either cigarette, spiral, or split rubber tube, is led out.

Closure of the Wound.—This is done in layers, with buried stitches of catgut and superficial stitches of silkworm gut. The dura is brought together and, when possible, the edges overlapped, unless decompression is aimed at, when it is left unsutured. Sutures are of No. 1 or No. 2 iodized catgut.

The bone-flap is replaced, attached to the galea, but no sutures inserted in it, as a rule. Periosteum, unless much stripped up, is left unsutured. Tension stitches of heavy silkworm gut are now inserted into the galea flaps, and between them approximation stitches of horsehair or light silkworm gut.

The wound is first washed with bichlorid, 1:1,000, then with alcohol, and finally sealed with tincture of benzoin and silver foil, or, less frequently, with collodion on narrow gauze strips.

Fluffed gauze is applied over the wound, and then a "doughnut roll" of gauze is placed around the wound to protect the bony flap and brain below it from external pressure.

Over the whole bandage a large combination is applied, and, lastly, a roller-bandage held with adhesive strips.

Stimulation of the Patient.—Before the operation the patient's left cubital space is prepared so that an intravenous infusion of normal salt can be given instantaneously, if necessary. A hypodermoclysis ap-

paratus for simultaneous administration of normal salt under both breasts is in readiness during the operation.

A hypodermic of 30 minims of camphorated oil, or 1/100 gr. digitalin, is given, usually before the patient leaves the table, if any evidence of shock or collapse be present, and he is put to bed with his head low. On returning to consciousness, the patient is allowed to suck ice, or is given a teaspoonful of hot water, whichever he prefers.

Normal salt enemata of a pint each are given at intervals of four hours for thirst and for purposes of stimulation.

I have never found continuous rectal administration of normal solution as satisfactory as its administration at intervals, owing to the inconvenience the tube causes the patient and the constant soiling of the bedding.

If post-anesthetic vomiting is prolonged, the stomach is washed out with a couple of quarts of warm water, which usually gives prompt relief.

When vomiting has ceased, the patient is put on liquid diet and, if convalescence is normal, a couple of days later on light diet, and at the end of the first week a general diet is allowed.

If there is considerable seepage of cerebrospinal fluid after the operation, the outer dressings are changed as often as saturated, and the inner dressings daily. Any stitches around which necrosis is threatening are removed at the daily dressings, and necrotic tissue is promptly clipped away. Tincture of benzoin is applied to the cut surface, and is usually swabbed over the whole wound at every dressing.

When dressings must be frequently changed, they are retained by a large figure-of-eight bandage instead of the roller.

Where there is no discharge of the cerebrospinal fluid, the dressings are not removed until the end of

the first week, at which time the stitches are taken out, tincture of benzoin swabbed over the wound, and the dressing reapplied for another week, at the end of which time it may be left off entirely. As long as cerebrospinal fluid continues to discharge, careful aseptic dressing must be continued. Use of the silver nitrate stick and tincture of iodin swabs hasten the closing of these fistulæ. Not infrequently they occur through a stitch puncture, especially if the stitch be left in too long. For this reason we often remove stitches as early as the fourth day, if the wound is well united, but usually from the fifth to the seventh day.

Occasionally, a patient will suffer pressure symptoms when a long open fistula finally closes. In such cases it must be reopened and then again gradually allowed to close.

Patients are usually allowed to sit up on the third or fourth day and leave bed at the end of the first week.

This concludes what I have to say on craniectomy. I fear I have already transgressed beyond my allotted time. Had I had more time at my disposal I should like to have considered the treatment of post-operative complications to some extent, and also the special technic in handling the different varieties of intracranial lesions,—the cysts and granulomata, as well as the tumors. I have also not had the space to discuss those two important operations of Cushing's, the subtemporal and suboccipital decompressions and their variations. Nor have I gone into the subject of epilepsy, both focal and "idiopathic," a subject in which both Krause and Kocher have recently made important advances.

I shall therefore have to leave these subjects to a further time, or until such time as the various members of the Association may do me the honor of visit-

ing my clinic. Then I may be able to demonstrate on the living that which here would take a dryer and also less instructive form.

FOR DISCUSSION SEE PAGE 178

REMOTE CONSEQUENCES OF HEAD INJURIES

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Pathologic conditions and aberrant mental states following head injuries, either as a coincidence or as a result, are of sufficiently common occurrence and of such grave import that they deserve more attention than has been accorded them. The text-book articles are far from exhaustive, and the literature on the subject is not profuse. There is a popular notion that a person is never mentally or physically right after a head injury. This is important on account of accident insurance and litigation. The possibilities of mental suggestion, malingering, and exaggeration are unusual. It is hard to place an exact value upon the influence of injuries, as compared with other causes, and to trace a definite relationship between injuries and pathologic results separated by long periods of time.

The consequences of cranial injuries occurring at the time of the actual injury or a few days thereafter, will not be considered in this paper, nor will an exhaustive discussion, or even mention, be attempted of all the numerous and varied pathologic processes which may ensue as the result of cranial trauma. Only a few of the most important and the most common will be considered, such as defects of the bony wall, hernia cerebri, late traumatic abscess, late apoplectiform attacks, traumatic epilepsy in its various manifestations, traumatic insanity, and traumatic cerebrasthenia.

Defects of the cranial wall alone may be dismissed as being of little importance, except that they render the brain more vulnerable in case of future injury. Combined with a wound or destruction of the dura, together with increased intracranial pressure, there results the condition known as hernia cerebri when the skin is intact, and as fungus cerebri when the brain substance is exposed as a fungous, granulating mass, dripping with cerebral fluid. Defects of bone and dura, unless accompanied with increased intracranial pressure, do not result in either of these conditions. Under normal conditions the brain has a slight minus pressure when the dura is opened so that, unless there is positive pressure from tumor, hydrocephalus, cerebral edema, operative or non-operative trauma, or some acute cerebral lesion, there is never protrusion. Hernia cerebri is a comparatively benign condition, while fungus cerebri is not amenable to successful treatment and is universally fatal.

Late traumatic abscess occurs infrequently, and is usually single, deeply seated, and of comparatively slow onset. As a rule, the later the development, the slower the onset. Depressed fractures of the vault and foreign bodies, such as bullets, splinters of bone, or any puncturing object remaining in the brain, are common causes. Blood-clots, either epidural or subdural or subcortical, and hemorrhagic areas may soften, become infected from the blood, and abscess ensue. Simple contusion of the scalp may be said never to produce late abscess, and fracture of the base seldom, if ever.

The average time for the occurrence of what may be termed "late abscess" is from three to five weeks after the injury, although months and years sometimes ensue, even to ten years and longer. Such abscesses are most common in the frontal lobes and motor areas,

less often in the temporal and occipital lobes and rarely in the cerebellum.

The symptoms of late traumatic abscess depend in general, upon the length of time which has elapsed, upon the site of the abscess, and the rapidity of its onset and development. In cases which occur a considerable period after the injury, the development is very slow, and the symptoms indefinite and variable, with complete subsidence at times. Headache, indefinite sensations in different parts of the head, temporary attacks of aphasia or other evidences of focal lesion, and general convulsions may be some of the introductory symptoms.

The fully developed symptoms may be divided into general and local. General symptoms are fever, disturbance of pulse-rate, vomiting, malaise, and general emaciation. Fever may be high, but is usually 101° to 102° F. It occasionally falls below normal, and changes may be sharp and sudden. Late traumatic abscess is seldom ushered in with chill. The pulse-rate is commonly below 70. Vomiting, in either its gastric or cerebral form, is usually present. Rapid emaciation is the rule, and there is high leukocytosis.

Local symptoms are those of increased intracranial pressure and focal symptoms, depending upon the location of the abscess. Headache, slowly developing, worse on the affected side and severe in character, dizziness, and pain and stiffness in the muscles of the back of the neck, are often present. Mentally, at first the patient may be excited and confused; later on there is mental apathy and stupor from which he is not easily roused.

Focal signs are various, depending upon the location of the abscess and the area of edema that surrounds it. Paralysis, rigidity, or spasm of local groups of muscles or of one side of the body, may be present.

Tingling, numbness, and crawling sensations of a transitory nature may be associated with them.

As regards the prognosis of late traumatic abscess: Two alternatives confront the victim, namely, death or operation. Death occurs either from rupture into one of the ventricles or from general exhaustion.

In a case reported by Daiber, a man fell, striking on the left occipital region, and was unconscious for five days. For ten years thereafter he remained well. After that lapse of time he had general convulsions with loss of consciousness. A few months later right-sided paralysis supervened, with occasional Jacksonian seizures, and death occurred at the end of twenty-three days. An abscess was found in the right-motor area, which was thought to be due to a contrecoup hemorrhage, as no evidence of fracture was found. English reports another case occurring after the same number of years, where, upon operation, an abscess was found in the temporosphenoidal lobe, under a depressed fracture. During the ten years the patient had been entirely well, except for occasional headaches and a single attack of acute pain in the region of the injury eight years after its occurrence.

Late apoplectiform attacks or symptoms occur in cases of skull fracture where there has been wide laceration of the brain substance. After a number of years during which certain symptoms have existed as a result of the injury, these symptoms are augmented, or others appear. English reports the case of a man hit on the vault by a brick with a resulting paralysis in the left leg, which disappeared in a few weeks. After a lapse of ten years the leg became almost completely paralyzed, the left arm considerably weakened, and the mental faculties much impaired. Frost reports a case where a man slowly developed paralytic symptoms twenty-six years after a compound fracture of the vault. Post-mortem examination showed a

number of small cavities from cerebral softening, together with general degeneration of the cerebral arteries, especially marked on the injured side.

When epilepsy occurs subsequent to a head injury, the question arises whether the injury is the only exciting cause, or whether it is merely the agent which increases some predisposition or pre-existing pathologic condition. Can a perfectly healthy man of perfectly healthy ancestry be made an epileptic by a blow upon the head, slight or severe? Is the blow the powder-magazine itself, or is it the spark which explodes the pre-existing magazine? The consensus of opinion seems to be that in a decided majority of cases the head injury whose relationship to a subsequent epilepsy can be definitely traced, is not the only cause, but that cerebral arterial disease, syphilis, alcohol, or other diseases which affect the brain, are present and form a suitable soil for the effect of the trauma.

Many men who have had severe head injuries, either accidental or operative, never develop epilepsy. On the other hand, a distinguished American surgeon has repeatedly declared his opinion that a fatal head injury is preferable to one in which there is a short period of unconsciousness, because he fears so much the possibility of resulting epilepsy. Epilepsy is one of the most common of the diseases of the nervous system, it being estimated that about 1 person in 500 is a victim of the disease. In about 1 per cent of these cases, trauma is an assured factor, either alone or in conjunction with some other pre-existing cause. It may be a factor in a larger percentage of cases, as a history of trauma may be had in many cases which can hardly be classified as traumatic epilepsy. A large percentage of the cases recorded in the Vanderbilt Clinic give a history of head injury. Gowers reports 3,000 cases of which 108 were classified as traumatic. On the other hand, there is the possibility that

many of the cases of so-called "idiopathic epilepsy" may be the result of injuries to the head during parturition from pressure, asphyxia, and instruments. One author states that as high as 60 per cent of the birth-palsies result in epilepsy.

Traumatic epilepsy may be clinically classified as (1) traumatic true epilepsy; and (2) traumatic focal epilepsy.

Traumatic true epilepsy is symptomatically the same as idiopathic epilepsy. There are general convulsions, which, at a less or greater period of time, follow an injury to the head. The injury may be slight, and no gross lesions of the brain or its membranes be recognized. In order to classify such cases as traumatic true epilepsy, it should be ascertained that the patient has never had general convulsions, unless the convulsions be such as occur in infancy and have no connection with epilepsy. The condition of the patient prior to the accident, especially as regards alcohol, syphilis, and degenerative changes, should be determined, and the injury should be of sufficient importance to be reasonably considered. The period of time elapsing before the development of the epilepsy merits consideration. Most cases develop within a year, although several years may elapse, and an undoubted authority states that twenty and thirty years may pass away, and yet a relationship be traced between the causal injury and the resulting epilepsy. In general, however, the relationship is difficult to establish in cases which appear many years after an injury.

Traumatic focal epilepsy, or Jacksonian epilepsy, is caused by a focal lesion. There is a definite pathological condition, varying in the different cases. Fracture of the bone, with or without depression or splintering, thickened or adherent membranes, wedges of connective tissue displacing brain substance, various

degrees of degeneration of nerve-cells, and chronic neurogliar changes, are fairly constant.

Two clinical varieties are recognized: (1) spasms of muscles or groups of muscles; and (2) general convulsions. In the first variety the character of the spasm frequently reveals the site of the lesion. Where there are general convulsions they may be preceded by an aura, which gives some idea of the original center involved. Visual impressions, flashes of light and color, disturbances of speech, olfactory or gustatory sensations, paresthesia, numbness, tingling, burning or painful sensations in limbs, trunk or face, and vertigo with opisthotonoid spasms, may be some of the pre-convulsive phenomena which indicate the centers involved.

The same question may be asked concerning traumatic insanity as of traumatic epilepsy: can a healthy person of perfectly healthy ancestry be made insane by a head injury? The same answer can be given. In rare cases a head injury may be the only cause, but usually there is a predisposition or suitable soil for the trauma. Hereditary predisposition, alcoholism, syphilis, epilepsy, arterial disease, sunstroke, irregularities of life, or some severe emotional or mental disturbance, or nervous shock, are commonly present and often outweigh the injury. In cases occuring years after a head injury it is difficult to decide what influence the injury had in producing the insanity, but there seems to be no doubt that tender scars, simple fractures, depressed fracture, concussion of the brain, and blood-clots are causative of insanity, in some cases, many years after the injury.

The forms of insanity produced by trauma are of no characteristic type. There are confusion, delusion, simple dementia, post-paralytic dementia, and epileptic insanity. True melancholia and paranoia, in their

narrowest sense, seldom, if ever, occur from head trauma.

"Traumatic cerebrasthenia," "traumatic neuroses," and "residual symptoms" are terms applied to a group of symptoms occurring frequently after head injuries. They comprise a number of physical affections and mental changes which make the subject less capable of pursuing the ordinary routine of life and of performing the work to which he is accustomed. There may be pain in the head, severe and lasting. Headache, which may last for years, is one of the most serious conditions. It may be neuralgic in character, resulting from a tender scar; in other cases it is fixed and intense and may be caused by osteosclerosis or meningeal adhesions. Sensations of numbness and tingling, a feeling as if a band were about the head, recurrent attacks of dizziness, during which the patient is semiconscious, and which are brought on or increased by a stooping posture, quick movements, or the use of alcohol or narcotics, are other conditions. The disposition may be entirely changed. The patient gets irritated easily, and angry over trifles; he becomes nervous; his sleep is disturbed or lessened; and there is intolerance of alcohol and tobacco; and high temperatures. He is often more than usually susceptible to febrile disorders; memory is impaired, and he is especially forgetful of the incidents connected with the accident. Many of these cases come to litigation. Epilepsy and insanity often follow them.

As regards the treatment of the results of head injuries: I wish to consider, briefly, their prophylaxis and late surgical intervention.

In all traumatisms of the skull the most important point is, not whether the patient will get well, but whether he will later suffer from epilepsy, insanity, or some traumatic neurosis; and the treatment of the

case must be carried out with special reference to remote consequences.

Strict antisepsis, control of hemorrhage, elevation of depressed fragments, removal of spiculæ and other foreign bodies, careful freshening and suture of wounds of the dura, and evacuation of clots, are of the utmost importance if we hope to avoid untoward results. It is a good thing for the physician or surgeon who first and last cares for these cases to remember to keep his fingers, septic instruments, and watery solutions of any kind out of these wounds. In case the wound heals, and it comes to the attention of the surgeon, showing a traumatic defect, Allen recommends operation before epilepsy develops. He removes the scalp from the site of the defect, dissects the connective tissue from the surface of the brain, excises a thin portion of the cortex, if it is adherent to the dura, examines the bony margin to see that it is smooth, and controls all hemorrhage. He then removes the scalp from an adjacent area equal in size to the defect, carefully preserving the periosteum, splits off the outer table of the skull with its periosteum, places it between two layers of gauze moistened with salt solution, and flattens it with a few slight blows of the hammer. The plate of bone is laid on the brain, the skin sutured over it, and a cigarette-drain inserted, which is removed on the second day. Seven cases were thus treated.

A second and most important consideration in prophylaxis is rest. The importance of rest for a long period of time, especially after slight injuries, was first emphasized by the late Christian Fenger. Complete mental and physical rest must be insisted upon for at least six weeks after head injuries. English found that where proper rest was secured the majority of cases had no untoward results. He insists on rest in bed for four weeks and supervision of the

patient for a long time thereafter. Isolation should not be practiced, however, as its results are unfavorable. Mercurial treatment in conjunction with forced feeding and massage was found to be of benefit.

General late surgical intervention means the elevation of depressed fractures, the dissecting out of an organized blood-clot, breaking up of dural adhesions, excision of portions of diseased cortex, evacuation of a subcortical cyst, and removal of foreign bodies, together with a number of other procedures that have been devised to fill in bony defects, prevent adhesions, and equalize the circulation.

In cases of Jacksonian epilepsy, with definite focal symptoms and definite lesion, the results are most promising, especially if the time elapsing since the injury is not too long, and the patient does not come from a neurotic family. Not all apparently promising cases turn out to be such, and apparently hopeless cases sometimes result in cure. Early operation before the habit is formed is far more likely to result in success than later operations. Surprising results, however, have been attained in late operations. By operation, the course of the disease may be favorably influenced for a time, but these favorable results are not always permanent. Repeated operations sometimes produce repeated benefit, and permanent cure of epilepsy following a third operation has been reported.

Closure of the bony defect has been attempted in a number of ways. Plates of silver, celluloid, or hard rubber, have been used in many instances, but not always with favorable results. In fact, in some cases the symptoms were not only not relieved, but were augmented, and the plates were removed. When intracranial pressure is normal there may be success. Fraenkel reports a case of paralysis and epilepsy in a young man who shot himself through the head. Two years later a box fell striking him on one of the de-

fects, and severe cortical epilepsy ensued immediately. The gaps in the skull made by the entrance and emergence of the bullet were closed with celluloid plates and eight years later the patient remained entirely well.

Some years ago Horsley advocated the removal of that portion of the precentral cortical area which by faradization was shown to be the center controlling the initial movements of the focal convulsion, and later operators have extended the procedure to portions of the post-central convolution.

In order to prevent adhesion between the skull and dura, Murphy employs a thin plate of coal-tar paraffin working it in between the dura and the edge of the bony defect. Egg membrane has been used to prevent adhesions between the dura and brain with results pronounced to be favorable. One surgeon proposes and practices sewing the edge of the dura to the periosteum, in order to prevent adhesions to the brain. Instead of attempting closure of defects, Cushing sometimes makes the bony defect larger in order that the edges may not irritate the brain so much as it rises and falls with the circulation and respiration.

Kocher advises making a bony defect, preferably over the "silent areas" of the brain and where the defect is covered by muscles, as, for instance, in the temporal fossa. The opening may be single or bilateral. Jonnesco has advised the extirpation of the superior cervical sympathetic ganglion. Repeated lumbar puncture has been followed by promising results in a number of cases.

Operations upon cases of traumatic insanity do not, as a rule, produce favorable issue. Fractures of the base or injuries producing extensive destruction of brain substance are especially unfavorable. Cases in which there is indication of localization in an acces-

sible region offer the best results. In 62 selected cases, Powell reports improvement of some character in 58.

Other late results of head injury sometimes ensue. Heddestrom of Upsala reports five cases of tuberculous meningitis following in a few weeks' time, apparently slight and trifling head traumas in persons previously supposed to be perfectly healthy. After injury slight brain symptoms developed and increased, till typical meningitis appeared from the twenty-ninth to the forty-fourth day. Autopsy showed tuberculous meningitis, and the unsuspected focus in the lungs or bronchial glands.

Of individual symptoms occurring as late results of head injury, a few may be mentioned, such as motor aphasia, amnesia, and agraphia. The arithmetical faculty is the one most commonly lost and the latest to return. The musical faculty is occasionally lost. Sense of smell may be lost by pressure upon the olfactory bulb. Inequalities of the pupil, accommodative asthenopia, and nystagmus are the most common results so far as the eye is concerned. Glycosuria may occur, but is usually early in appearance, rather than late.

DISCUSSION OF THE PRECEDING EIGHT PAPERS

DR. JOHN H. RISHMILLER (Minneapolis, Minn.): As an illustrative case, I bring this man before you to show the unique end-result which may sometimes be obtained in cranial surgery. Briefly, the history of the case is as follows:

One afternoon, in January, 1908, I received a telephone message to come and see Mr. R., a student freight-brakeman, aged 27, who, I was informed, had, two and one-half days previously, sustained a head injury. Upon removing the dressing I noticed that the right eye was almost closed and that a suture had been inserted. At first I concluded that I had to deal with an infected wound, and decided to remove the suture and open the wound. After removing the stitch, a slight gushing pulsation was detected with each heart-beat, and on further

examination a depressed fracture of the skull was detected. The fracture was located on the forehead, just below the edge of the scalp, and on a perpendicular line which would strike the outer part of the right supra-orbital arch.

The history of the accident was this: Two and one-half days previous to the time I examined the patient, while he was going down the side of a box-car, which at the time was passing a cattle-pen, the gate of which had been left open, he had been struck in the right side of head by the gate.

After examining the case, I applied a firm head-bandage and sent him to the Swedish Hospital. His temperature was normal, and he had no objective or subjective symptoms other than was revealed by the local condition. I kept him at the hospital for a short time, under observation, having the pulse, temperature, and respiration taken every four hours, with the patient constantly in the recumbent position.

Naturally, there was only one thing to do, and that was to operate. Dr. Halstead has stated that it is his practice to have the patient's scalp shaved and prepared on the night previous to the operation, but, as you all know, the scalp is one of the dirtiest parts of the body, and I wish to remark that this patient's scalp was prepared immediately previous to the operation, as one is very liable to nick the scalp in shaving and slight staphylococcic infection is liable to start over night.

As you notice, I made a liberal incision, about five inches long, and the following conditions were revealed: There was a small oval opening through the outer table of the skull about large enough to admit the tip of my little finger. Upon sponging, I noticed a dark object through this opening in the skull, which I thought might be a coagulum of blood. With a pair of tissue-forceps, I removed this object (showing the specimen), and on examination it was revealed to be a piece of felt. After I had sponged again, another grayish object could be seen through the opening, which, after removal and examination, was found to be a piece of cotton (showing specimen). The above maneuver was repeated once more, and lastly a piece of leather (showing specimen) was removed.

It is self-evident that he had been wearing a hat, and that the end of a bolt in the door of the cattle-pen had crushed through the skull, carrying with it the pieces from his hat. Next, I enlarged with a pair of rongeurs the opening in the outer table of skull sufficiently to remove the depressed inner table, the which, you will notice on the patient's skull, was about 1¼ inches in diameter. This size is also confirmed by the speci-

men which I hereby show you (showing specimen of inner table of skull). I was very careful to remove all the comminuted fragments from the cranium, and I wish distinctly to state that on careful examination the dura was found uninjured. There still was this continuous oozing which I had encountered at my first visit at his home, which came from one of the diploetic vessels. I closed the scalp wound with silkworm-gut sutures, leaving a small opening for drainage from the excessive diploetic oozing at the point where the bolt penetrated the scalp. The wound healed by first intention, and the drainage opening gradually became occluded.

One satisfactory end-result of the case is, that the inner table has entirely closed the craniectomy opening, and upon firm pressure with the fingers there is absolutely no "give" of this newly formed inner table, although, as you notice, the outer table has not closed over. Now, then, recalling your embryology or the anatomy of an infant's skull, I would like to call your attention to the fact that the dura and pericranium at the fontanels are almost inseparable at the edges of the cranial bones, and as the infantile bones of the skull grow they spread the dura one way and the pericranium the other, and the dura, as shown in this exemplified case, has osteogenetic properties, the same as the pericranium.

I was not only anxious for you to see the patient, but was very desirous to know what after-results I had obtained. In response to the inquiry whether he has had any objective or subjective symptoms, the patient tells me that he has been perfectly well, that he has suffered from no uncomfortable symptoms, not even from heat or cold, and the only objective condition revealed, as you notice, is the resultant scar and the want of re-formation of the outer table.

In conclusion: I wish to remark that the main reason why I obtained such a gratifying result for the patient was that the dura was not injured, as a scar in the dura is one of the main causes for the development of cerebral fibrosis, caused by the adhesion of the scar to the cortex, and the subsequent development of mental defects. I would like to ask Dr. Connell to examine this case and report to the Association his findings.

DR. F. GREGORY CONNELL: (To patient) Do you have any trouble?

THE PATIENT: Not at all.

Question: Any headache?

THE PATIENT: No.

Question: Do you have any pain or tenderness, and do you suffer from cold?

THE PATIENT: No, not at all.

DR. CONNELL: Examination reveals a complete bony regeneration at the site of the old injury. There is no tenderness, and the patient seems to be in perfect physical and mental condition.

DR. CLAYTON H. CHARLES (Goodman, Wis.): As Dr. Shields has stated, the subjects,—contusion, concussion, and compression,—are very important to emergency surgeons; but the differentiation between them is more difficult and less important if considered too narrowly, than some writers would have us believe. Dr. Shields' paper shows a great deal of study and experience, and I have enjoyed it.

The differential diagnosis of brain injuries is at once difficult and fascinating. Many old notions have been replaced by new conceptions of what really happens or is the true pathology in these conditions.

The two conditions,—concussion and contusion,—merge so into each other that we are compelled in the course of many cases to change our diagnosis as time elapses. The effect of concussion, theoretically at least, is immediate and is characterized by unconsciousness of shorter or longer duration. If unconsciousness is prolonged, some contusion has no doubt taken place; in fact, it is a question if there is not some slight contusion in every case where there is loss of consciousness. Again, after a longer or shorter period following the condition we have diagnosed concussion, symptoms of compression may commence showing slow hemorrhage, the result of contusion.

To reiterate Dr. Shields' statement: "Every case of compression and contusion is traumatic, and concussion may be."

The reference to the punishment or execution of criminals by contusion, or, rather, intermittent slight shocks to the skull, was very interesting, and teaches us how very sensitive the brain tissue is to repeated or continued insult, while we are all able to recall cases in point that lead us to think the brain will tolerate immeasurable insult, as, for instance, severe penetrating or gunshot wounds with loss of brain tissue. This seems paradoxical, but is true.

It is obvious that experimentation with the brain has its great difficulties and limitations; hence the many theories and opinions that prevail as to brain physiology and pathology and

the many changing ideas or even misconceptions of the true condition.

While the study of the mechanics of brain injury is interesting as research, it is hardly helpful or practical to us as emergency surgeons.

It is possible to have some degree of concussion without loss of consciousness. Brains differ as to their sensibility or susceptibility and equilibrium, and the symptoms manifest from any given degree of injury vary, while perhaps the pathology is almost identical.

The doctor has stated that the blood-pressure varies in compression in any given case. Not only is this true, but the symptoms of and tolerance to compression vary in any individual in any given injury.

Lumbar puncture has been suggested as a valuable diagnostic help in the differential diagnosis of these conditions. While the presence of blood in the cerebrospinal fluid may indicate contusion or laceration, our findings in this quarter will not tell us the degree, and it is so susceptible of error and consequent misconception it would hardly seem to me a very advisable procedure in view of the fact that it has some dangers and tells us so little that will help us in the treatment, which, after all, is the prime object of our studies along these lines.

As to the excluding of the diagnosis of alcoholic intoxication by absence of the alcoholic breath, etc.: I will say that many errors have been made through those first ministering to a case, calling it "a faint" and making an effort to administer alcohol in some form, as is quite usual, thus giving us a wrong clue. We must be guarded in our diagnosis. Never call it a "drunk" until you are sure. To make such a blunder once, impresses us with its importance for all time.

From a careful study of the subject I cannot help but feel that it is only a matter of degree, and the three merge one with the other, or slip from the so-called classic symptoms of one into those of the other so gradually and imperceptibly that the three words hardly have value, except in a general classification of brain pathology, for use in description or discussion. They are simply convenient markers rather than each being a separate and distinct pathologic condition.

In compression, one author mentions the peculiar blowing motion of the lips in expiration.

Severe contusion not causing severe compression manifests itself generally by agitation, delirium, convulsions and contractions, and delay of febrile symptoms.

The most salient symptom of compression is paralysis, except in case of hemorrhage or tumor into the convexity of the hemispheres or into the ventricles, when prolonged tonic muscular contracture is most prominent.

As to what becomes of the results of injury or how Nature takes care of the pathologic condition: Two or three points may be of interest. Blood extravasated between the layers of the arachnoid is a common occurrence, and three things may happen to it, but we cannot say why: First, it may be absorbed; second, undergo organization; or, third, form a false membrane or cyst and take on the secreting action of all cysts, with increase of pressure symptoms. The increase of pressure from this cause is, many times, no doubt, wrongly diagnosed as second or repeated hemorrhage. All effusions between the dura and the brain are susceptible of absorption.

It is probably true that the real integrity of the brain is not compromised so much by the mere compression itself as by the secondary conditions, as anemia, inflammations; and, indirectly, the effect of pressure on the respiratory center.

Under treatment, the essayist advises the shaving of the head and careful inspection of the skull for fracture. While this is always advisable, and many times we are thereby enabled to locate the fracture if it exists, we must bear in mind that the inner table of the skull can be punctured without evidence externally. Sometimes the test which elicits the presence or absence of the cracked-pot sound on percussion may be a help.

As to treatment: I believe the two greatest essentials are absolute rest and continuous skilled observation; the one to allow Nature a chance to go her limit in repair, and the other to be ready for surgical intervention at the earliest possible moment it is needed.

Early operation is perhaps commendable, but we should weigh carefully our patient's chances, and choose for this unconscious man, who is so completely and without choice in our hands, the course we should wish chosen if our positions were reversed. We all have seen repeatedly the wonders that complete rest and Nature can work with strong, healthy men such as we treat.

When symptoms of compression persist following injury, I believe we should always trephine, even though we are unable to localize the seat of trouble, if for no other reason than to relieve the pressure at the base, where it is most harmful.

Where stimulants are called for in these cases I think camphorated oil should always be thought of, as well as inhalations of ether when the heart fails.

DR. ROGER T. VAUGHAN (Chicago): I have not much to add to Dr. Crafts' extensive and thorough-going discussion of the subject of the symptomatology of organic lesions affecting the sensorimotor areas. I should like, however, to mention some recent experimental work by Krause described in his large work on "Cranial Surgery," which shows that a *pure motor aphasia* may be produced by excision of Broca's area. For many years there has been an active controversy between the German and the French schools of neurology as to whether aphasia is always of a mixed type or may be occasionally purely motor or purely sensory. I think Krause has shown definitely that Marie's view, that every type is a mixed type, which has aroused so much discussion, is wrong. Krause has also shown by numerous excisions of the cortex in cases of focal epilepsy that the motor areas lie entirely anterior to the Rolandic fissure, and that in no case of excision of the areas posterior to the Rolandic fissure do any motor symptoms develop.

I also wish to lay stress, as did Dr. Crafts, on the importance of *retrograde amnesia as a symptom of concussion,* particularly in connection with skull fracture. It is rarely absent in severe concussion, but can be demonstrated usually immediately after the injury when consciousness returns, and it persists sometimes for long periods after the injury.

At the meeting of the American Association of Railway Surgeons last year I showed a boy who had a very extensive retrograde amnesia following fracture of the skull. At the time of his injury he was in the second year of high school. The retrograde amnesia which followed his injury was so extensive that on return to school the boy was able to qualify only for the third grammar grade. All his school knowledge beyond that period had been lost as a consequence of the injury. The amnesia was the striking point in the case, but a careful examination showed there was distinct mental deterioration present, as well as the memory defect. I am inclined to believe that all of these cases probably of extensive retrograde amnesia go along with some degree of mental deterioration, which, however, is usually relatively slight as compared with that present in the other organic dementias.

I also wish to agree with Dr. Crafts in warning the surgeon against assuming that every mental defect following a cranial trauma is necessarily the result of that trauma. For instance,

Dr. Halstead and I have at St. Luke's Hospital at the present time a man who came in for scalp wounds after a head injury. There was no history of distinct loss of consciousness, but there was present more or less confusion, disorientation, and somnolence, and a superficial examination led one to presume that this was probably the clouding of consciousness following concussion. When, however, these symptoms failed to clear up in a couple of weeks, a careful neurologic examination was made, and it was then quite evident that the man had a beginning general paresis, the physical signs, as well as the mental symptoms, being present. His Wassermann test was also positive, and he gave a history of luetic infection. Since his condition has not changed to date, we have every reason to presume that his was purely a case of the by no means infrequent traumas to which early paretics are so liable.

I wish now to demonstrate to you a *pocket electric ophthalmoscope* which I devised recently while in Vienna. In getting it up my object was to have an instrument for direct as well as indirect examination of the fundus which I could always have with me. I have found that if I carry an ophthalmoscope continually in my pocket I look at a great many fundi, whereas, if I do not, I rarely examine them. For many years I have carried about with me a pocket electric flashlight for looking into pupils and mouths, therefore, I had this electric ophthalmoscope designed simply to screw into this flashlight in place of the bulb. (Alois Schwarz, the optician on Spitalgasse, made the instrument for me.) I have only had a few simple lenses put on it to suit my own accommodation. They are ten in number, and I have found them, in the year that I have had the instrument in use, entirely adequate for my work. The cost of the instrument is only about one-third that of the other electric ophthalmoscopes on the market, and it can be carried in the pocket almost as readily as a fountain pen. It can also be so focused that a maximum amount of light is available for the indirect method, and a minimum or as little as one may require for the direct method. To neurologists, internists, and surgeons who do considerable cranial work, I can recommend it highly as the easiest means of following cranial cases from day to day. The ophthalmologist who only sees them from time to time is not really available enough for the surgeon who has to tell from day to day whether the wound should be reopened, whether it should be left entirely alone and is doing all right, or whether some further operation may perhaps be indicated.

DR. JOHN STEELE BARNES (Milwaukee, Wis.): In five minutes I cannot begin to say what I would like to on this topic, because it is so broad and intensely interesting that one can only begin to get started.

We are to be congratulated on having presented here so complete and systematic a paper on ocular manifestations in cranial injuries, because in the literature we find nothing but detached papers on certain phases of the subject. Dr. Wright has given it to us rather completely and as a whole subject.

I shall have time to take up merely the consideration of the question, that all ocular manifestations are due, when we are able to get the complete analysis, to intracranial tension. As I take it, the value of the oculist to the surgeon in these cases is his ability to determine for him the symptoms of pressure as shown by the eye. And it is not at all strange that we should turn to the eye for the index to intracranial tension when we take into consideration the close anatomic relation of the eye to the brain, nevertheless it has been only within the last few years that the appearance of the eye-grounds has been accepted as an evidence of intracranial tension. While all of the ocular manifestations as enumerated so completely by the essayist are of value and should be noted, carefully weighed, and properly interpreted, I believe the two most valuable means we have at our command are the appearance of the fundus of the eye as shown by the ophthalmoscope, and the visual fields as shown by the perimeter, therefore, I believe any examination of a head injury is not complete without an ophthalmoscopic examination, and, as soon as the patient is conscious and able to co-operate, a chart of the visual field obtained.

From its development history and from its structure, the optic nerve is to be considered as part of the central nervous system. Throughout its entire extracranial course it is enveloped in sheaths, which are direct prolongations of the meninges, and between these sheaths there are spaces, which are a continuation of those between the meninges of the brain. The wider and more important of these intervaginal spaces is the subarachnoid, because of its direct relation with the subarachnoid space of the brain, which contains a relatively large amount of the cerebrospinal fluid, and is again in direct communication with the cerebral ventricular system. The position at the base of the brain of the intracranial optic nerves, with their commissure and tracts, renders them especially liable to injury from direct pressure. Keeping these facts in mind, it can be easily understood why and how the optic nerve is

implicated, to a greater or less extent, in nearly all head injuries.

At the present time there is a decided difference of opinion as to the pathogenesis and mechanics of these ocular manifestations, and also as to the proper term by which to designate them; but I think it is immaterial whether you call it "choked disc" or apply the more recent term, "papilledema." I still stick to "choked disc."

To attempt to differentiate the process of development of one choked disc from that of another is futile, and I do not believe that a differentiation is justified, either from a clinical or pathologic standpoint. Of course, clinically, that is by what we see with the ophthalmoscope, we cannot be sure what exactly the cause of the process is. Of one thing, however, we are sure, and that is, that increased intracranial pressure is the one cause that we have the most certain knowledge of, for it has been abundantly demonstrated by surgical experience for many years that a release of increased intracranial tension arrests and cures choked disc. At the first examination, in many cases, you will find no evidence of a chocked disc, but if the retinal veins be darker and more distended and uneven than normal, the imminence of choked disc is very probable and the eye-grounds should be closely watched. When you find a distinctly blurred and indistinct disc with the physiologic cup wanting, obscuration of vision, interlacing color-fields, or a reversal of color fields, I would operate at once.

The differentiation between the various stages of choked disc as described by de Schweinitz, a modification of Gunn's original classification, I consider more theoretical than practical. If redness of the disc, with blurring of the upper and lower margins, with a gradual progressing of the blurring to the nasal edge while the temporal margin is still visible, represents the first stage of choked disc, which is as de Schweinitz describes it, then I am seeing the first stage of choked disc very frequently in normal, healthy individuals. The appearance of the disc as just described with even the physiologic cup wanting pertains to many eyes with errors of refraction, so, in considering eye symptoms in cases of head injury, we must eliminate errors of refraction. How easy it might be to make a mistake in diagnosing a first stage of beginning choked disc, was brought to my attention recently.

Mr. M. was thrown from a wagon in a runaway, was picked up unconscious, and remained so for several hours. I did not see him for a week after the accident, but the history was that

he did not suffer from any other symptoms than a mild headache and a vertical diplopia on regaining consciousness. There was a paresis of the superior rectus of the left eye, showing an involvement of the 4th nerve. Dr. Crafts has just told us that the 4th nerve is rarely, if ever, affected in head injuries. In this case, however, the rare occurrence happened, and, strange to say, the 4th nerve was the only one affected. With his error of refraction corrected vision was normal. Examination of his eye-grounds showed in the left the classic picture of a beginning choked disc, and I am sure I should have diagnosed it as such had I not known that the condition was a normal one for him, for he had been a patient of mine for several years, and I had examined the eye-grounds many times previously. Anyone having seen that fundus for the first time after the head injury would undoubtedly have made a mistake, and the case demonstrates the difficulty in knowing whether you have a first stage of choked disc in any case.

A rapid development of choked disc would certainly be an indication for trephining. Cushing and Bordley state that, sooner or later, choked disc appears in all cases of basal-bursting fractures.

The visual fields, as Dr. Wright has told you, will show many peculiarities and variations. The color-fields may be entirely lost, or they may be reversed or interlaced. The phenomenon of the color-fields so far seems to be a mystery. The field for form may, or may not, be very much contracted. You may have a hemianopic field or only a quadrant missing. There is no particular field that is found in all. Perhaps the most distinctive field indicating increased intracranial tension is the reversed color-field, that is, where the red is larger than the blue.

I would not base a conclusion for operation on the ophthalmoscopic findings alone, unless they were very marked. The visual fields, light sense, obscurations of vision, etc., must also be taken into account; but if there is an appreciable amount of choked disc you must operate early if you expect to preserve vision. Dr. Wright has so thoroughly set forth the other ocular manifestations that nothing further occurs to me as an addition.

I am glad to hear Dr. Wright take issue with Zentmayer in the statement that choked disc is not produced by an abscess of the brain. Like Dr. Wright, my experience shows that an abscess of the brain will produce choked disc, and that Zentmayer is too radical in his conclusions. I had a case of double ab-

scess of the brain, one in the temporosphenoidal lobe and one in the cerebellum, which had a well-marked choked disc. That it was caused by pressure and not a toxic condition was proved by its improvement by draining the temporosphenoidal abscess. What the ultimate result might have been I cannot say, as, unfortunately, the boy suddenly died.

I wish to emphasize that, in all head injuries, whether fracture of the skull is present or not, an early examination of the eyes should be made and at frequent intervals subsequently.

Dr. F. Gregory Connell (Oshkosh, Wis.): In regard to indications for cranial operation: Dr. Halstead did not lay great stress upon therapeutic decompression in cases of fracture of the base with increased tension. I believe that in this particular condition it is a most effectual method of treatment.

In regard to the technic of such operations: Many methods have been devised and recommended for preventing hemorrhage from the vessels of the scalp. I can most heartily concur with the essayist as to the value of the rubber constrictor. The late Christian Fenger always used that method. We use the ordinary office supply elastic bands, but I have used sections of the inner tube of automobile tires, and, find them well adapted for that purpose. By putting such a constrictor over moist gauze, tapes to hold it in place will be unnecessary.

Regarding the making of incision: Dr. Halstead says that those who are doing cranial surgery every day need no measurements. That is undoubtedly true, but for those who do not do cranial surgery every day, I certainly would advise that they make most careful measurements and mark them out on the scalp with an anilin pencil the day before.

As to instruments. Of course the mallet and chisel are practically abandoned at the present time. I can most heartily recommend the Hudson burr (when it does not meet with bony resistance it does no more cutting), and then the use of the De Vilbiss, and various rongeur forceps, as satisfactory in making an osteoplastic flap. A Gigli is free from dangers, as Dr. Halstead says.

The point made by the essayist as to the use of the *x*-ray in locating large vessels, is to me most important and should be well worth remembering. Hemorrhage from the bone is readily controlled by methods mentioned, and hemorrhage from the sinuses can always be overcome by gauze packing. and can almost always be controlled by a suture in the wall of the sinus. The text-books and most articles on the subject say that hemorrhage from the venous sinuses of the skull is of no moment

because there is a negative pressure in the veins and venous sinuses. That is true under normal conditions, but in the conditions for which we open the skull we often find increased tension in the veins and sinuses.

The incision in the dura should always be made far enough away from the edge of the bone so that there will be ample room for suturing. If I understood the essayist, he advocates imbricating or double-breasting the dura in closing it. This is most desirable, but I have never been able to overlap the dura. I have considered myself fortunate when able to get the edges together, but have never been able to cross them.

The trocar needle for taking out some of the deeper tissue for microscopic examination has been practically abandoned, as the essayist says, and is not necessary.

In treating abscess of the brain one point should be emphasized, and that is the exclusion of the subdural space by gauze packing before evacuating the pus. As to whether brain abscess should be irrigated or not: If under really low pressure it can do no harm, but if irrigated it should always be under very low pressure. With ample drainage the change of tension between the surroundings and the abscess cavity will, in a large number of these cases, make it unnecessary to irrigate. In draining an abscess cavity in the brain the tube should always be split or cut spirally, not a solid rubber tube on account of the necrosis which might be caused by pressure of the tube.

In regard to secondary operation for hernia cerebri: When we can, as Dr. Rishmiller has shown, prevent the cerebral tissue from protruding through the opening, I believe we can get bony union in all such cases. But the trouble is to keep the brain tissue out of the opening. In a case of hernia cerebri which occurred about six months ago, I transplanted a piece of fascia lata into the opening between the skull and the dura and had primary union. There is not bony union as yet, but the hernia is cured.

FRACTURE OF THE NECK OF THE FEMUR AND ITS TREATMENT

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Fractures of the femoral neck are common injuries and constitute about 6 per cent of all fractures. They occur at all ages, but most frequently in old people.

The hip is greatly exposed to the effects of violence, in fact, more so than any other part of the body. This becomes evident when we observe that the hips, notably in women, project far out from the median plane of the trunk, so that when one falls on the side, the site of impact is immediately over the great trochanter. The concussive force is sustained by the projecting neck of the femur, which rests against the fixed pelvis. A double force is brought into action in hip fractures: (1) the impact against a resisting surface, and (2) the contrecoup force through the weight of the opposite heavy hip and the pelvis being brought against it.

The peculiar anatomic adjustment and its powerful muscular supports give the femoral neck remarkable immunity against fracture until senile structural changes set in. Until these are established the femoral neck rarely, if ever, suffers disorganization from force transmitted from its leverage, the extremity below.

The crushing force in fractures of the neck must always be direct and concentrated immediately over the outer aspect of the hip, over the great trochanter.

Definite diagnosis of this fracture may be at times simple enough, and again attended with great diffi-

culty. The most marked signs are pain, loss of power in the limb, deformity, crepitus, and shortening. The shortening may be slight at first, but may after a few days increase to two or three inches. The displacement in fracture of the neck of the femur is due to the action of the glutei, the pectineus, and the adductors, as well as the iliopsoas and the obturator externus muscles. Another marked deformity is eversion of the foot from external rotation of the limb. This deformity is due to the external rotator muscles. The great trochanter is above Nélaton's line. The fascia lata between the crest of the ilium and the trochanter major is in a relaxed condition. The whole extremity lies helpless, and it is impossible for the patient to raise the heel, while lying upon the back.

Before examining the patient the history of the accident should be obtained. Then all the clothing should be removed, and the patient placed upon a firm and even surface. Anesthesia is hardly ever necessary for diagnostic purposes. The hip and limb should be handled with all possible care, as there is danger of an impacted fracture being changed by careless or rough handling. By placing the hand on the great trochanter, the thumb in front and the fingers behind, one can usually discover any irregularity, displacement, or tenderness. Any pre-existing disease or injury of the hip should always be carefully investigated before any measurements are made. The patient should be on his back, in a straight position, with the legs alongside of each other, and steadied while measurements are made from the anterior superior spine to the tip of the internal malleolus upon each side. The position of the great trochanter should also be determined with reference to Nélaton's line. In cases of marked eversion dislocation of the hip must be excluded. If the leg is rolled outward, dislocation of the hip forward might be suspected, but

the absence of the head of the bone anteriorly and other positive signs should eliminate dislocation. If the leg is rolled inward, a dislocation with the head of the bone upon the dorsum ilii should be considered. The presence of the head of the bone in the acetabulum is convincing proof that no dislocation exists. The Röntgen ray should, if possible, be utilized to clear up all doubts as to a correct diagnosis.

In the treatment it is necessary, as in all fractures, to secure perfect adjustment of the fragments and maintain immobilization. Perfect adjustment usually occurs when traction is made in line with the normal axis of the femoral neck, if the capsular ligament and the surrounding muscles have not been destroyed. Sufficient traction in the normal line of the femoral neck compels the capsular ligament to act as a close-fitting sleeve, and thus to adjust and align the fragments. This traction being maintained will insure a continuous and undisturbed relation of the fragments.

There is a tendency for the lower fragment to fall behind and then be drawn upward and inward while it is usually rotated outward, causing an upward and inward displacement of the lower fragment. This places the anterior part of the capsule across the upper fragment, which is frequently tilted forward, and if proper traction is made it will carry the upper fragment now free of any muscular attachment, passively into line. The action of the psoas and iliacus is normally that of flexors with internal rotation. When solution of continuity occurs in the femoral neck they immediately become pronounced external rotators, and often force the soft parts between the fragments. By so doing they make union impossible unless the impediment is removed, first by flexion, which raises the line of muscular action above the fragments. Then make and maintain traction on a line with the normal

femoral neck, thus preventing tissue from being caught between the fragments.

The method then in the Ruth-Maxwell treatment of fractures of the femoral neck is as follows: With the patient on the back, first flex the thigh on the abdomen to relax the psoas and iliacus and bring their line of action above the neck of the femur and so prevent them from forcing soft tissue between the fragments. Then make extension while an assistant makes traction outward and raises the trochanter major to the same level as its fellow. From fifteen to twenty-five pounds weight is now to be put on over a pulley to make downward extension of the leg. This is accomplished by the ordinary Buck's extension with wide adhesive straps extending well above the knee. A piece of leather with the upper edge curved out, to prevent cutting of the skin, is put on the upper part of the thigh, to which a cord is attached and extended through a pulley at the side of the bed. About one-third of the amount of weight used at the foot, is put on at the side extension. This lateral pulley must be placed at such height and have sufficient weight to overcome the tendency to eversion, and to carry the trochanter to a level and of equal prominence with the opposite side. When this is done the direction of the pull will be outward, ten degrees upward toward the axilla and forward at an angle of about forty-five degrees. The counter-extension for the longitudinal and lateral traction is made by the patient's weight. The foot of the bed is raised enough to overcome the tendency of the patient to slide toward the foot of the bed, and amounts to from ten to fifteen inches, according to the amount of weight required to overcome the muscular action. The side of the bed corresponding to the injured limb is also raised enough to overcome the tendency of the patient to be drawn towards the lateral pulley. The tilting required will be from two to five inches.

During the last year I have treated two cases with the Ruth-Maxwell method, and in both instances secured union, in the first case without shortening, and in the second case with one-half-inch shortening.

CASE 1.—Section-hand, aged 23. Injured by a hand-car with six men on it passing over his hip and the lower part of his body. Shortening of one and one-half inches was found on first examination. Longitudinal extension with 15 lbs., and lateral extension with 4 lbs., was put on, which was gradually increased to 25 and 8⅓ lbs., respectively. The shortening of the leg gradually diminished as the weight was increased and the muscular contraction overcome. After six weeks the weights were gradually decreased, and eight weeks after the injury the weights were all removed. The patient was then kept in bed for four weeks more, and during this time he was allowed to roll around as he pleased. Careful and frequent measurements were made to ascertain if any shortening had occurred. Result: perfect recovery without any shortening.

CASE 2.—Woodsman, aged 45. Injured by a log-jammer with block and tackle falling on his hip. Shortening, 2 inches. Treatment, longitudinal and lateral extension. Weights gradually increased until shortening and muscular contraction were overcome. This patient was a large muscular man, and it required 57 lbs. at the foot, and 19 lbs. at the side to overcome muscular contraction and reduce the shortening. Result: union with one-half inch shortening.

The abduction treatment of fractures of the neck of the femur, originated by Whitman of New York, is claimed to possess advantages over other forms. In this method the patient is anesthetized and placed on a pelvic rest, the limbs being supported. The shortening is then reduced by direct manual traction, aided by pressure on the projecting trochanter, the limb being

rotated inward so that the position of the foot corresponds to its fellow. It is then slowly abducted under traction to the desired degree, preferably to the normal limit, the sound limb serving as a model both as to rotation and abduction. The body and the limb are firmly and smoothly covered with sheet-wadding and cotton-flannel bandages, all bony points being carefully protected. A long plaster-spica support is then applied from the toes to the axillary line, accurately moulded about the trochanter, enclosing and supporting the entire buttock and strengthened beneath the hip by a band of steel of the size and shape of the Thomas hip-splint.

CONCLUSIONS

1. Of all fractures this is by far the hardest to treat, on account of the age and physical condition of a large per cent of the cases.

2. The situation of the injury makes constraint of body and limb compulsory for a long period of time.

3. The difficulty is to secure apposition of the fragments on account of their position, shape, and relation.

4. Repair requires a long time and depends on accurate adjustment.

BIBLIOGRAPHY

C. E. Ruth: "Anatomic Treatment of Fractures of the Femoral Neck." Jour. of the A. M. A., Nov. 29, 1902.

Royal Whitman: Annals of Surgery, April, 1911.

C. L. Scudder: "The Treatment of Fractures." (Seventh edition.)

FOR DISCUSSION SEE PAGE 205

SUPRACONDYLOID FRACTURE OF THE FEMUR, AND ITS TREATMENT

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Fracture of this bone is of comparatively frequent occurrence, forming from 6 to 8 per cent of all fractures, the neck and middle third being the most frequently broken. (I shall not include the upper extremity of the femur in this paper.) The femur may present any variety of fracture to which any long bone is liable, whether it be from direct violence or muscular action. The line of fracture is usually oblique, but a transverse fracture is not uncommon, especially in children, leaving the periosteum intact, thus preventing any or very slight displacement of the bone. Such cases are often overlooked on account of practically no deformity. I have had a few of these cases which would have been very difficult to diagnose without the aid of the *x*-ray, and, by the way, I do not think any fracture should be reduced until an *x*-ray picture has been taken, giving the surgeon an accurate knowledge of that with which he has to deal.

The next fracture that I am going to speak of is the supracondyloid, which is the most common, the most troublesome, and the hardest to treat. I am going to include the intercondyloid fracture, those of either condyle and separation of the lower epiphysis, as the same exciting cause may produce any of these injuries at the lower end of the femur. The fracture that I speak of is an oblique one, just above the condyles, the line of fracture running downwards and back-

wards, the upper fragment being driven down into the popliteal space, crowding in front of it and injuring the popliteal vessels and nerves which may cause a primary or secondary hemorrhage or gangrene of the leg. The usual line of fracture is from above downward and forward, the lower fragment tipping backwards and the upper being driven downward and forward. The sharp end of the upper fragment is frequently driven through the soft parts, including the synovial pouch and skin, converting this serious simple fracture into a compound one.

When a functional disability of the knee results, following a supracondylar fracture, it is usually due to the forward displacement of the upper fragment, which interfered with the movements of the patella. Although we may have limited knee-motion in cases where we do not have any bone interference, as this skiagraph that I now hand you will show, this patient has a stiff knee; she is able to flex her leg to about right angles to the thigh, but she can extend it perfectly; and she has quite a limp, which, I think, is due to the stiffness of the knee. This was a compound fracture, the upper fragment passing through the synovial pouch and skin, causing quite a profuse hemorrhage. We considered ourselves very fortunate in not having an infection, and the wound healed in about three weeks, although we did not get any bony union until the eleventh week, and it was about six months before she could put any weight on her leg. The patient was in bed for sixteen weeks, and while there was almost no shortening, she now has one inch. This amount of shortening in oblique fractures of the femur is about that which is generally accepted by surgeons as being legitimate.

In intercondyloid fractures the condyles are separated from the shaft and from each other. The shaft

is first broken and then is driven down and penetrates the lower fragment, splitting and separating the condyles and opening the joint. Usually, however, the condyles are completely detached from each other, and sometimes separated far enough to allow the patella to sink in between them. Either of the condyles may be displaced backward so as to give an inner or outer rotation of the leg.

Traumatic separation of the epiphysis of the femur is of quite frequent occurrence. Although the epiphysis may not unite to the shaft before the twenty-fifth year, none of the reported cases have been over twenty years of age. The cause in almost all cases has been great violence in over-extension or abduction. The cases that I have had were due to twisting the leg in the spokes of a wagon wheel. It may be caused by trying to overcome an ankylosed knee. When this accident occurs, the periosteum is usually torn from the shaft of the femur for several inches. The usual displacement of the epiphysis is forward or to one side. When forward, it has frequently passed upward on the anterior surface of the shaft of the femur. The knee-joint is not often involved, but the capsule may be torn and the joint filled with blood and exudate.

The emergency method of putting up a fractured thigh for transportation is of no little importance to the railroad surgeon, as most of our patients have to be transported to a hospital or to their homes, which necessitates more or less handling of the broken leg, and it is necessary to transport such cases with the greatest degree of comfort and safety. In order to do this the hip- and knee-joints should be extended, the leg being held straight. If a compound fracture, apply a wet antiseptic dressing to the wound in the soft parts. The limb should be placed upon a board which has been well padded, using cotton if you have it; if you have none you may use sheets, towels, or

anything that will prevent the splints from injuring the soft parts. The board should be a little wider than the thigh and leg, and should extend from the lower third of the leg to the upper part of the sacrum; the outside splint should extend from the axilla to the foot; the inside one from the groin to the knee. All of these splints are, of course, carefully padded. A heavy pad or a small pillow should be placed inside of the long splint to prevent any rubbing or injury to the side of the chest. These splints are held in place by an assistant while slight traction is being made; then apply a few turns of a bandage above the ankles, just below the knee, above the knee, the middle of the thigh, and about on a level with the perineum while the long end of the outside splint is held in place by a wide bandage around the body.

The patient should immediately be placed on some improvised stretcher and moved to his home or a hospital, put to bed, anesthetized, and a careful examination of the parts made to ascertain the relation of the fragments. If the ends of the bone are near the skin we must be very careful to prevent the sharp ends from cutting through the skin and converting a simple fracture into a compound one. An assistant must steady the thigh while the surgeon grasps it above the knee, putting on enough traction to overcome the muscular resistance. While the pull is maintained by an assistant the surgeon puts the fragments in place. He then puts on a Buck's extension and applies the coaptation splints and a long side splint.

"Traction in the long axis of the leg may not correct all lateral displacement. Traction applied at right angles to the long axis of the leg over the side of the bed, will assist materially in reducing the lateral displacement." (Scudder.)

As for the weight attached to the Buck's extension: I do not think you can lay down any fixed rule; we

must add enough to overcome the shortening. The weight that is usually used is from 15 to 20 lbs. for an adult, but you must use the required amount to get the extension.

You will require less weight in a transverse fracture than in an oblique one. The comparative measurements must be made daily for some days. The time that is usually required for bony union to take place is from six to eight weeks, but I have had them take from twelve to sixteen weeks before they were able to be out of bed. I consider this injury a very serious one, requiring under the best methods of treatment confinement to bed for weeks, and entailing considerable disability and lameness for months.

FOR DISCUSSION SEE PAGE 205

OPERATIVE TREATMENT OF FRACTURES OF THE FEMUR

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Fractures of the femur is a subject to which practitioners of the healing art have given a great deal of attention in all times, and perfect results, especially in adults, have not been expected by even the most skilful and painstaking.

It is very difficult, especially in subjects of heavy build, to make a satisfactory reduction, or even, if made, to retain the fractured ends in apposition long enough for union to take place. It is also more difficult to maintain reduction of the fracture if it exists in the upper or lower third; in the upper third there is a very decided tendency for the proximal piece to tilt upwards and outwards, so drawn by the iliopsoas, gluteus minimus, pyriformis, oburator internus, gemelli, and quadratus femoris muscles. If the fracture is in the lower third there is lateral displacement, and the upper fragment will be drawn inward by the adductor brevis, longus, and upper part of the adductor magnus; while the portion of the adductor magnus which is inserted into the inner condyle has a tendency to tilt the distal fragment outward, and the gastrocnemius draws it slightly backward, thus producing enough displacement to allow the ends of the bone to slip by each other if the extension should not be ample at all times. It is in these two regions where it is so difficult, especially in adults, properly to retain the

fragments in apposition that operative measures are often called for to obtain the most desirable results.

I wish it to be understood that I am not an advocate of the open method for all cases of fracture of the femur before first attempting proper reduction and retention by the old methods and the use of the *x*-ray to ascertain if proper position is, or is not, maintained. If so, well and good; if not, there is ample reason to justify an open operation, and, if everything can be had favorable for the patient, the operation should be done.

Various materials and methods have been made use of in open operations, such as the use of ivory pegs, steel nails, wire, and the steel plates of Lane, etc. The ivory pegs in my judgment have no place in bone surgery, and the steel nails have but a limited use and that in intracapsular fracture. Wire may, under certain conditions, be used to good advantage, but on the whole the Lane method and steel plates is by all means the best in approximating and holding the broken fragments in apposition until union has taken place.

These plates are now made of steel that is strong and flexible. They are very thin as compared with those of several years ago, and hence not so apt to act as disturbing elements and will therefore not have to be removed so frequently.

The open operation should be done as soon as possible after one is convinced that the fragments cannot be held in proper position by traction and splints. The patient should be taken to a well-equipped operating-room, where all the suitable tools for holding and adjusting of the bones are at hand, also plenty of *capable* assistants. The patient is placed under ether, and the entire thigh and leg made as thoroughly aseptic as possible by tr. of iodin and alcohol. The operator and all assistants, including the nurse who handles

instruments, should have their faces masked, wear heavy rubber gloves, and be most careful not to puncture or lacerate the gloves while at work.

The incision should be made at a point over the fracture most accessible, and at the same time where the least harm is done to the soft parts, avoiding, of course, important blood-vessels and nerves. The wound should at once be made of sufficient length so that, by proper retraction by the assistants, the bones can be reached with the instruments designed and at hand for the purpose. There should be plenty of drills of just the proper size for the screws, so that, in case of one or more breaking, there are others to fall back on. The fragments should be brought and held in proper line, so that, when the plate is in place there will be no eversion or inversion of the foot.

In transverse fractures where there is considerable overriding, the bone-ends should be projected through the incision by pressure made by an assistant on the inside of the thigh. In this way the ends may be approximated, locked, and pushed back into proper alignment, and there held by the assistants until the plate is properly fastened, and the wound sutured all but a space of about two inches where drainage by means of layers of gutta percha or iodoform gauze should be made, which may be left in place for a few days and then removed through a fenestrum in the cast. I think drainage in cases where there has been a great deal of trauma is to be recommended no matter how perfect one's technic may be. I have never regretted that I drained in these cases, but I have regretted on two occasions where I did not drain.

DISCUSSION ON THE THREE PRECEDING PAPERS

DR. GEORGE M. STEELE (Oshkosh, Wis.): Papers and discussions to be of the greatest service should be intensely practical. In obedience to this principle I shall touch briefly

only upon the important questions which occupy, more or less, debatable ground.

The important issues are diagnosis and treatment. The essayist, in his excellent paper, has well considered the field of diagnosis, and I will pass this part of the paper by only asking if "Bryant's iliofemoral triangle" is not worthy of a prominent place in the solution of this often difficult problem.

Dr. Nelson advocates a line of treatment which is, to my mind, highly commendable, and with some modification has been employed by myself with quite satisfactory results.

To replace the severed parts as nearly as possible to their normal relations, and then to retain them, maintaining them with the minimum of disturbance, is our problem. There is no doubt that this result can be obtained with the greatest precision by suturing or pinning the fragments together; but this method, until more proof is forthcoming, commends itself in few cases. The risks are so great, the superiority of results still questionable, and the necessary surroundings so rarely present, that this procedure can be ruled out in the large majority of cases. Only skilful operators with mechanical minds should attempt this method. The Buck's extension, with side support, to my mind, fulfills the principles of treatment which secure the greatest comfort during confinement to bed, the nearest to perfect replacement of parts, and can be adopted in all hospitals and households. It is thoroughly practical, easily obtainable, and not difficult to execute. In all cases a fracture-bed should be used, if possible. It saves much pain in the necessary manipulations during confinement and adds much to Nature's possibilities in repairs. The weight and pulley never sleep, fixed extension does. Mechanical aids are springing up which possess merit, but rarely can be secured when wanted. Few of these are hospital cases.

External traction in moderation should probably be secured, though it can be overdone and either separate the fragments in some cases too far for union or apply conflicting forces, with extension, to the adductors. So, also, there is questionable advantage in adduction, as movement in the joint is more readily secured than correction of fractured parts.

I believe that rest of the extremity is of vast importance, and the dressing which secures this result offers the better chance for rapid recovery, and may furnish the *sine qua non* for union in the cases otherwise vicious. It is my belief that no combination with which I am conversant offers better chances for good results than the Buck's extension and long side-splint. The

splint allows of little movement outside of the hip-joint, and the external and downward traction upon the femur can be secured to any desirable extent. In no case where this treatment has been chosen in my practice can I recall a confirmed crutch- or cane-user. Do-nothing treatment is reprehensible.

It occurred to me, as this subject came up, that skiagrams of former cases would somewhat enhance the value of the discussion, and I have secured a couple of such which I shall present. These were what I could at once command:

CASE 1. Mrs. L., 83 years of age, injured fifteen years ago, when 68. Shortening from one-fourth to one-half inch. For years gives no indication of such injury by her walking or use of leg.

CASE 2. Mr. C., 80 years of age. Injured six years ago, when 74. Shortening from one-half to three-fourths of an inch. Only slight change in gait.

These cases were treated at their country homes and on a fracture-bed. Each case seemed to be impacted, and, as you see, the result is perfect union.

One swallow does not make a summer, and these two cases do not settle any question, but they seemed unpromising when first seen.

DR. FRANK S. WILEY (Fond du Lac, Wis.): There is absolutely nothing to add to Dr. Eitel's excellent and conservative paper on fracture of the femur. The subject can be summed up in a nutshell: In treatment of fractured thigh, if under an anesthetic, the fracture can be easily reduced and can be held in place, operative intervention is contra-indicated. If, on the other hand, under an anesthetic it is impossible to bring the fractured ends in apposition or impossible to hold them there, the open method is absolutely demanded. Of course, in doing railway surgery one has to take into consideration that we may have not only a fractured thigh to contend with, but oftentimes a complication of injuries, such as fractured ribs and extensive contusions and lacerations. In dealing with a fracture one has to take into consideration all the complications that are possible in these conditions. In some cases it would be necessary to put on a permanent dressing at once in order that the patient may be moved and kept off from some other serious injury. A surgeon who attempts to treat a fractured thigh or a fracture in any location, has to use good common sense and his best judgment in dealing with it.

DR. JOHN H. RISHMILLER (Minneapolis, Minn.): Limbs are frequently fractured some distance from the place where

the patient is to receive permanent necessary treatment, and it is therefore of paramount importance to apply an emergency apparatus which is practical, easy of application, and comfortable and safe for transporting a patient.

In fractures of the femur, both the knee- and the hip-joints should be immobilized as much as possible, applying the same principle in transportation as in the permanent treatment of a fracture; that is, immobilizing the joint above and below the fracture. The limb should be placed upon a heavily padded board, about five inches wide, extending from the back part of the chest to the point where the muscles of the calf slant off, and another heavily padded board, four inches wide, should be applied, extending from the axilla to the side of foot. It will be more comfortable to place an extra-heavy padding behind the popliteal space for raising the knee slightly. The two board splints should be then held in position by a snugly applied four-inch wide bandage. This furnishes support to the back part of the fractured extremity and does not squeeze the limb laterally. The upper ends of the two splints should next be applied snugly to the chest and trunk by a firm muslin or linen swathe. The patient will be more comfortable if placed on a mattress which directly rests on the floor of the baggage-car, as a cot allows too much swaying with the movement of the train.

Considerable anxiety is always entertained as to the correct diagnosis of any injuries about the hip, although a fracture of the shaft of the femur is easily recognized. Skiagraphs, whenever possible, will help us more than will any other known means. Four salient features will mainly help us in arriving at a correct conclusion:

1. Loss of function of the whole extremity. A patient with a fracture of the neck of the femur, impacted or non-impacted, when requested to raise heel from cot, bed, or floor on which he rests, will not be able to raise the foot. This point is of great diagnostic importance and one which has not received due credit. So far, I have never found it to fail in either eliminating a fracture or corroborating its presence.

2. Distinct eversion of the limb, so that its outer border rests upon the bed, with the exception of impaction of the anterior portion of the neck, in which case inversion will be present. This eversion is due, in fractures of neck of femur, to the loss of support of the leg to the side of the pelvis.

3. Shortening of the injured extremity as compared with the uninjured one. This point of diagnosis I nearly always

eliminate or confirm by measuring with a tape from the anterior-superior spine of the ilium to the lower edge of the internal malleolus and comparing the measurement of the injured extremity with that of the non-injured.

4. Elevation of the great trochanter and relaxation of the fascia lata. Another point of diagnosis is to extend the tape from the anterior superior spine to the tuberosity of the ischium. Under normal conditions the tape should pass exactly above the upper border of the great trochanter. The same measurement should be taken upon the healthy side and the two compared. The amount of the elevation is the same as that of the shortening of the limb. On palpation one will find the fascia lata relaxed between the crest of the ilium and the great trochanter. Bryant's triangle also gives us some information.

The Ruth-Maxwell method of extension has been ably described by Dr. Nelson, and I wish to add that, in certain cases, if properly applied, admirable results are obtained. In fact, in some cases we are practically compelled to employ it to get satisfactory results.

In Buck's extension my plan to determine how much weight to apply is to start with, say, about twelve pounds and increase this one pound a day until both legs measure the same; in other words, the weight must be proportionate to the muscularity of the individual, that is, sufficient to overcome the action of the long muscles. Any fractured bone requires close daily scrutiny and observation, and in the case of a fractured femur, measurements should be taken every second or third day, in order to determine exactly its length as compared with normal.

In cases where the periosteum has been extensively lacerated and denuded from the fractured extremity it is apparent that the time of disability is considerably more prolonged than in those where the periosteum is torn with a clean break of the bone without extensive trauma and bruising. Also in cases where there has been considerable crushing of the soft tissues and comminution of the bone, it must be borne in mind that Nature will take care of the soft tissues first for recuperation and lastly the osseous tissues, so that in severe injuries, such as a crush of an extremity by being run over by a carwheel, I do not expect bony union to commence until all the soft tissues have completely healed. The above facts I have over and over corroborated in my experience. Furthermore, I wish to add that in these severe crushing injuries, where the fragments

cannot be held in apposition in order to obtain functional result and where one is compelled to hold the fragments in apposition by mechanical means, such as Lane's steel bone plates, I should not advise an operation until the soft tissues have recovered their vitality, and callus-formation has commenced, which in some instances may be six weeks to two months after the primary injury. I have a case on hand at present which verifies the above statement where a car-wheel crushed over the fore-arm and the hand has been saved.

DR. FRED J. PATTON (Duluth, Minn.): I would like to make a few remarks in regard to some cases I have had and concerning several important points which have not, I believe, so far been considered.

First. The advisability of taking skiagrams of every fracture of the shaft and neck of the femur. In these cases the condition is such that you do not actually know by sense of touch or by the eye exactly what exists there. You may have as a patient a great big healthy man who has a thigh almost as large as a telegraph pole, in which event it is very difficult to locate the fracture by palpation. In those cases skiagrams would be of the utmost value.

About a year ago one of the claim-agents referred to me the case of a fence-builder out on the Brooten line. The track was in such condition that it was rough riding on the hand-car, which finally jumped the track, and this man sustained a fracture of the neck of the right femur. Dr. Graves attended the patient, who was laid up six weeks or more, and afterwards he went around with a decided limp. The claim-agent brought him to Duluth, and upon taking measurements we found that there was only between three-fourths and 1 inch shortening of the right leg. I took a skiagram of his right hip and then of his left hip and compared them, and found that Dr. Graves had secured a very, very good result, which was so pleasing to the patient when he saw the skiagrams that he was willing to settle with the Company for much less than he had first wanted.

There is one important point in skiagrams, and to illustrate it I wish to refer to another case. Last winter while a young school-boy was sliding down one of the avenues, his hand-sled overturned and he sustained a fracture of the femur. I was called in the case. I found one-half inch shortening, so put the limb up in plaster-of-Paris. I kept him in the cast for three or four weeks, but found he did not improve, that union was not taking place. I took a skiagram and found that the frag-

ments had been twisted so that one periosteal surface was against another periosteal surface.

Second. This brings up the subject of the importance of taking measurements. I believe that measurements should be taken of these injured limbs as often as possible. In the case of the boy, three weeks after putting the plaster cast on the shortening had gone up to one and one-half inches, which made us suspicious, and so we took the skiagram with the above result. We found that, under an anesthetic, we could almost get the leg down to its normal length as compared with its fellow. In all cases of fracture of the femur the patient should, I believe, be anesthetized before it is put up. This is contrary to Dr. Bloodgood's teachings, but, in my opinion, a man can better bear the burden of an anesthetic than the possibility of a bad limb for his lifetime.

DR. DANIEL D. MURRAY (Duluth, Minn.): In further confirmation of the general opinion that we should always have an *x*-ray of all fractures, I would like to relate some circumstances connected with a case I had a few years ago, not a railroad case, however. A young man of about 19, while working on a roof, fell off and fractured his femur in the upper third. He was a very unruly patient, and I had a lot of trouble with him. I put the limb up in the usual way as best I could and secured a good result under the circumstances. But the young man, after getting well and going home, limped considerably, and about six weeks afterwards I was waited upon by his father and threatened with a malpractice suit. The old gentleman went to see a physician here in town who had just purchased an *x*-ray apparatus and was anxious to try it. So the father was rather encouraged in his purpose by this doctor. He took a skiagram of the limb. This fact surely saved me from a lawsuit. They were so well pleased by what the skiagram revealed that the old gentleman came down himself and presented me with a copy of it, complimenting me highly on my good work, for there was absolutely no evidence of any fracture having taken place. This rather aroused my suspicions, and after diligent, though very guarded, inquiry I found that the doctor had taken a picture of the wrong thigh.

DR. CYRUS N. CALLANDER (Fargo, N. D.): One point in connection with the open method of treating fractures was not mentioned: We are, of course, all fearful of the results of this treatment, chiefly because of infection. It has been my experience, that, while in some cases I have been obliged to use plates, there are other cases in which some mechanical cause for the

difficulty in reducing the fracture is found at the time of operation. Having failed to reduce the fracture, possibly under one anesthesia or under the second, the open method is used as a last resort, when we find there some spur of bone, some peculiar type of fracture, which, as soon as it is seen, makes plain the necessary manipulation of the fragments that will adjust the lines of fracture accurately, so accurately that to put on a plate would be taking the chance that we fear, i. e., of infection. So in some cases I think it is quite possible that, while doing the open operative work, we may still avoid either the use of ligatures, wire, or plates, if we but get the fracture set accurately and then properly immobilize the joints above and below.

One other point: In taking skiagrams of fractures in or about the joints, it has been my experience that, unless those are taken in various planes, we cannot determine the proper method of manipulating the fragments into position and are compelled then to do open work; but with skiagrams taken in various planes we can study the displacements more accurately, and then possibly correct them even without any open operation.

Dr. Theodor Bratrud (Warren, Minn.): I wish to mention one little point which probably many of the members of the Association know of, it is so simple. In treating fracture cases in hospitals, many times two assistants are required to hold the end of the extremity and two more to hold the limb above. I have not seen the fracture in which we cannot overcome the shortening simply by taking one part of the Ferguson bone forceps, or any stiff instrument with a hook on the end of it, and by using the end of the lower fragment as a fulcrum and hooking the other end over the upper fragment, you can always bring the fragments down into apposition without any one exerting force or tension upon the extremity.

Dr. Charles A. Stewart (Duluth, Minn.): When I was a student in medicine at Cleveland somewhat over thirty years ago, a suit for malpractice was brought in a case in which there was shortening of the limb following treatment for fracture of the femur. Professor Thayer, of the Western Reserve University, took measurements of 150 cases, and found that in over half of those cases in which there had been no fracture there was a difference of ½ to 2 inches in the length of the legs. So it seems to me that when we depend on measurements to determine whether or not there has been any shortening, it would be necessary to do like the patent medicine men,—get a picture "before and after."

DR. NELSON (closing): While I have not had very great experience with fractures, referring to Dr. Rishmiller's statement that one could add as much weight as may be needed: This is true, but it hurts the patient considerably to add a lot of weight, and you have great trouble to persuade him to stand the pain. In the second case, I was following the directions which had been given by Dr. Rishmiller in the first case, and this patient was kicking extremely hard against the treatment. He said he would rather die or have a crippled leg than to submit to the adding of weight. I finally, as stated in the paper, had 57 lbs. on it, and it was hard to get him to stand the pain that this caused, not the pain of the fracture because that did not hurt him at all.

I would also like to ask if any of the members present have had experience with the abduction treatment of fractures of the neck of the femur. It seems to me that adding so much weight by the Ruth-Maxwell method is rather barbarous treatment, and that if there is anything better it ought to be taken up. I do not know anything about the abduction treatment, not having tried it, but have read about it and believe it would cause less pain than the Ruth-Maxwell. In some cases Dr. Whitman uses extension and in some not, the leg is abducted as far as it can be made to go and kept in a plaster cast for about four weeks.

DR. RIDGWAY (closing): I have no further remarks to make except that in passing the skiagram I do not want the surgeons of the "Soo" to think that we always have as poor results as that, because we do frequently get good results, but not perfect. I noticed in looking over the literature that an eminent surgeon in San Francisco had his assistant measure 100 individuals who attended his clinic, and he found that 50 per cent of those who never had sustained a fracture of the leg had all the way from one-quarter to three-quarters of an inch shortening. And it is possible that in the cases in which we have absolutely no shortening, the leg sustaining the fracture is the long one. Of course, I have never measured a leg previous to fracture, but from experience I believe it is almost impossible to get a perfect result in fracture of the femur. We can get it so close that there will be no limp and no functional impairment, but the skiagrams that I have seen have never shown an absolutely perfect result, and I have never heard of one except in Dr. Murray's case, in which the wrong leg was skiagraphed.

DR. EITEL (closing): There is only one thing that I wish to add and emphasize, and it is, that, in operating on these fracture cases and using the Lane plates, it is of the utmost importance that the fragments be held by assistants in such a manner that, when the plate is fastened, the shaft will have the proper alignment. The success in obtaining this will greatly depend upon the assistance rendered by those who are holding the fragments while the operator is drilling the holes for the screws which are to fasten the plate to the bone. If this is not carefully carried out, one is liable to find that there will be either inversion or eversion of the foot, which is not easily overcome unless noticed before the wound is closed.

I should like to report briefly a case that I am sure is of interest to every one of us here:

A man while washing windows fell from the third story of a building, striking the sidewalk with both feet and fracturing both femurs and also his lower jaw. I did my best to reduce the fractures properly and succeeded very well on the left femur, which was about in the middle of the shaft; but was unable to do so on the right, as the fracture had taken place well towards the condyles. I decided at once to administer ether and make the reduction by the open method. I wired the fragments and succeeded very nicely in getting splendid apposition. The wound was drained with strips of iodoform gauze, as has been my custom for years in such cases. Very much to my surprise, about a week after the accident it was found that both thighs about the seat of the fractures contained large collections of pus. Had the pus only formed in the thigh that was treated by the open method I should, of course, have attributed the infection to a fault in our technic, although we were as careful as we knew how to be.

The case went on from bad to worse, no union of bones took place, and the patient was in bed for about two months, and finally died of exhaustion from the enormous discharge of pus.

DR. F. GREGORY CONNELL (Oshkosh, Wis.): How long after the injury occurred did you operate?

DR. EITEL: About twelve hours after the accident.

INJURIES DESCRIBED ACCORDING TO ANATOMIC RELATIONS

J. RHODES LONGLEY, B. S., M. D.

FOND DU LAC, WISCONSIN

In presenting a paper of this kind I want it understood that it is merely a series of suggestions, through a review of surgical surface anatomy to stimulate more definite reports so the head of the Department may more easily draw a mental picture of the injury and, also determine early what the prognosis will be. Finally, when we get a definite nomenclature and outline easy to follow we can have better forms and blanks to aid in our descriptions.

Injuries to Scalp.—The term is, no doubt, turned in many times with no further explanation, but we should remember that there are five layers of scalp, *i. e.*, (1) skin, (2) subcutaneous fatty layer, (3) muscles-aponeurosis, (4) subaponeurotic layer, and (5) pericranium.

It is especially important to state when an injury involves these deepest tissues, and, in addition, the point at which the injury is located, as at such a distance from the cranial prominences, such as bregma, inion, glabella, etc., and give the direction of the wound, longitudinal, transverse, oblique, or stellate.

Injury of Face.—The sides of the face have prominences, such as the malar, orbital, etc., from which the distance to the injury can be described in centimeters or inches. The depth, as to whether injury is through the cheek, the nose, etc., and particularly the direction,

is important, for we know, *e. g.*, severing of Steno's duct distal to the gland is of little consequence, while proximate to the gland means a permanent fistula, giving us a very difficult patient to deal with in settlement, while at first it may have appeared to have been a very trivial affair.

The Neck.—Injuries here should be noted with relation to the vertebræ, anterior and posterior triangles, as well as their subdivisions (submaxillary and lingual), also aided by hyoid and mastoid prominences; always attempting to hold the head upright; *i. e.*, between flexion and extension.

Upper Arm.—This region extends from the lower limit of the "shoulder" or insertion of the pectoralis major medially and deltoid externally, to the upper limit of the region of the elbow; *i. e.*, two or three finger-breadths above the condyles. Injuries, then, of the arm region are transverse, longitudinal, etc., and are such a distance from the biceps and the deltoid prominences, axillary space and elbow, and involve such and such structure, also anterior-posterior, medial, or lateral sides.

The Elbow.—Injuries about the elbow are often very definite. The elbow region is about two or three finger-breadths above and below the fold. Here we have three very prominent muscular elevations: (1) biceps prominence, (2) extensor group prominence, (3) flexor group prominence. In addition, the two condyles, olecranon, radial head, etc., are the descriptive points.

The Forearm.—This must be more definite than usual, for many injuries extend into the elbow or wrist area and are not so stated. This region extends from the elbow region to two or three finger-breadths above the radiocarpal joint. We should also have a constant position of the arm, which is best in supination, *i. e.*, little finger alongside of body; in like manner we have

ulnar or medial sides of the arm and the radial or lateral sides. Injuries are such distances from the flexor and extensor muscle prominences, olecranon, head of radius or styloid.

The Wrist.—This is two finger-breadths above and below the radiocarpal joint. Injuries are transverse, longitudinal, etc., and such distances from the styloid and the thenar prominences.

Hand and Fingers.—Oftentimes we have an injury to the palm. Its relation to thenar and hypothenar prominences and the base of the fingers should be stated. Rather than say 1st, 2d, 3d, 4th, and 5th fingers, the head of the Department, I believe, recommends thumb, fore, middle, ring, and little fingers, and I think it to be a better nomenclature. In addition injuries are longitudinal, transverse, proximal or distal, lateral or medial, and anterior or posterior. The phalanx should be proximal, middle, and distal, rather than first, second, and third, because many would confuse the direction to count.

Thorax.—Here the common injuries, such as fractures, contusions, etc., are in the axillary and mammary lines, certain distances from the sternum, scapula and vertebræ, and over definite ribs.

Anterior Abdominal Wall.—Injuries here are either in—

Right	Middle	Left
Hypochondriac	Hypochondriac (or Epigastric)	Hypochondriac
Lumbar	Umbilical	Lumbar
Iliac	Hypogastric	Iliac

And in addition, certain distances from the xiphoid process, costal border, umbilicus, anterior superior spine, or pubes.

Wounds of the Back.—These are described as to direction and relation to the vertebræ, scapula, ribs, sacrum, and ilium.

Pelvis and Perineum.—Here we have bony landmarks to describe from, such as pubes, ischial tuberosity, and trochanter.

The Hip.—The hip is divided into two parts:

a. The posterior or gluteal region (buttocks).

b. The anterior region, including the hip-joint and the subinguinal region of Scarpa.

a. Is bounded above by the iliac crest, below by the gluteal fold, internally by the sacrum and coccyx, and externally by a line from the anterior superior spine to the great trochanter.

b. Is bounded above by Poupart's ligament and below by a line 12 to 15 cm. on a level with the gluteal fold, so the injuries to the hip are not just above the trochanter, but are so many cm. or inches from these boundaries and prominences.

The Thigh.—This is the region below the hip as described above to 5-8 cm. above the patella. The direction and distances from the patella and condyles are probably sufficient for description.

The Knee.—This covers a larger area than is generally thought, *i. e.*, two or three finger-breadths above the patella to the tuberosity of the tibia. The prominent points for description are the patella, condyles, and tuberosity. Posteriorly, we have muscle prominences, such as the biceps laterally, the gracilis, semimembranosus, and semitendinosus.

The Leg.—This extends from the tuberosity of the tibia to the base level, or malleoli. The anterior tibial border or shin is a good landmark. The terms "middle and upper third" junctions and "lower and middle third" junctions are merely relative, hence the distance and direction should be such from the tibial border, malleoli, and tuberosity of the tibia and perhaps the "calf" of the leg.

The Ankle.—This is two or three finger-breadths above and below the malleoli. The injuries bear certain relations to the medial and lateral malleoli.

The Foot.—The foot has prominent marks, such as the tuberosity of the calcaneum, the base of the metatarsals, scaphoid prominences, and finally, the 1st, 2d, 3d, 4th, and 5th toes, the same relation of phalanges as hand.

The sum of the above applies to both preliminary and final reports; however, in the final reports the condition, such as contracture, ankylosis, and loss of function, should be accurately described. Lastly, I would suggest that we attempt to have outlines and skeletons made on the back of the revised question-blanks, so that the injury can be drawn with red ink exactly.

DISCUSSION

DR. F. GREGORY CONNELL (Oshkosh, Wis.): This contribution by Dr. Longley is most timely and instructive, one which would be well worth studying. A man can hardly grasp all the points made by simply hearing the paper read, and closer study will be most beneficial to our own anatomic knowledge, and certainly most helpful to the Chief Surgeon and his records. If we follow out the suggestions as made this will doubtless show us once more that there are no *little* things in surgery.

PHYSICAL EXAMINATIONS

JOHN H. RISHMILLER, M. D.
MINNEAPOLIS, MINNESOTA

The following synopsis of our physical examinations on the whole system from January 1, 1912, to January 1, 1913, will convey a comprehensive idea of the number of men qualified and disqualified, the conditions for which they were disqualified, and the number examined at each division point by our different examining surgeons:

	Qualified.	Disqualified.	Total.	Percentage.
Chicago	45	31	76	40.78
Stevens Point	159	66	225	29.33
Bismarck	78	26	104	25
Minneapolis	690	181	871	20.78
Superior	267	52	319	16.3
Gladstone	107	19	126	15.07
Enderlin	258	45	303	14.85
Thief River Falls	132	23	155	14.83
Fond du Lac	338	55	393	13.99
Duluth	1	..	1	0.0
Manitowoc	6	..	6	0.0
	2,081	498	2,579	

Total percentage of disqualifications, 19.3.

	Qualified.	Disqualified.	Total.
Agents	24	12	36
Operators	281	82	363
Helpers	170	52	222
	475	146	621

Percentage disqualified, 23.51.

CAUSES FOR DISQUALIFICATION

Defective vision	113	Varicose veins of both legs	2
Defective hearing	87	Dupuytren's contraction	2
Color-blindness	47	Scabies	2
Inguinal hernia	25	Caries of spine	2
Patulous inguinal canals.	18	Underweight	1
Ventral hernia	3	Traumatic malformation of chest	1
Umbilical hernia	1	Occluded nostril	1
Convex glasses (far-sighted)	26	Ganglion of wrist	1
Albuminuria	21	Chronic eczema	1
Chronic valvular heart lesions	18	Chronic psoriasis	1
Syphilis	14	Anaemia	1
Refused vaccination	13	Chronic synovitis of knee.	1
Acute gonorrhea	11	Cleft palate	1
Chronic gonorrhea	5	No teeth in upper jaw	1
Glycosuria	7	Dermoid cystoma over coccyx	1
Underheight	7	Lack of pronation and supination	1
Stiff fingers	6	Tuberculosis of femur	1
Amputated fingers	6	Fractured deformity of tibia and fibula	1
Amputated thumb	2	Depressed cranial fracture	1
Amputated toes	3	Asthma	1
Very large varicocele	5	Epilepsy	1
Goiter	5	Carbuncles	1
Tape-worm	4	Hammer-toe	1
Alcoholism	4	Defective resolution of lung	1
Partial elbow ankylosis	4	Pediculi	1
Partial knee ankylosis	3	Chancroides	1
Partial ankylosis of hips, following trauma	1	Choroiditis	1
Hydrocele	3		
Insufficient chest-expansion	3		
Undescended testicle	2		498

MEMBERS

ARRANGED BY DIVISIONS, SEPTEMBER 1, 1913

JOHN H. RISHMILLER.	Chief Surgeon	Minneapolis, Minn.
CHARLES D'A WRIGHT.	Chief Oculist	Minneapolis, Minn.
GEORGE G. EITEL	Consulting Surgeon	Minneapolis, Minn.
KNUT HOEGH	Consulting Surgeon	Minneapolis, Minn.
FREDK. A. DUNSMOOR.	Consulting Surgeon	Minneapolis, Minn.
JUSTUS OHAGE	Consulting Surgeon	St. Paul, Minn.
GEORGE W. FOX	Consulting Surgeon	Milwaukee, Wis.
JOHN B. MURPHY	Consulting Surgeon	Chicago, Ill.
ALBERT E. HALSTEAD.	Consulting Surgeon	Chicago, Ill.
LEO M. CRAFTS	Consulting Neurologist	Minneapolis, Minn.
DAVID N. KEE	Examining Surgeon	Gladstone, Mich.
THOMAS J. STRONG	Examining Surgeon	Enderlin, N. D.
ALBERT M. FISHER	Examining Surgeon	Bismarck, N. D.
AXEL W. SWEDENBURG	Examining Surgeon	Thief River Falls, Minn.
FRED J. PATTON	Examining Surgeon	Duluth, Minn.
JOHN C. ADAMS	Examining Surgeon	Superior, Wis.
CARL VON NEUPERT, Jr.	Examining Surgeon	Stevens Point, Wis.
FRANK S. WILEY	Examining Surgeon	Fond du Lac, Wis.
JOHN F. PRITCHARD.	Examining Surgeon	Manitowoc, Wis.
ROGER T. VAUGHAN	Examining Surgeon	Chicago, Ill.

WISCONSIN AND PENINSULA DIVISION

LOUIS A. NIPPERT	Minneapolis, Minn.
RICHARD J. HILL	Minneapolis, Minn.
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ALBERT E. BOOTH	Minneapolis, Minn.
EDWARD E. AUSTIN	Minneapolis, Minn.
HENRY L. ULRICH	Minneapolis, Minn.
GEORGE E. BENSON	Oculist Minneapolis, Minn.
LOUIS R. KOLLER	Oculist Minneapolis, Minn.
JOHN B. DARLING	St. Paul, Minn.
JAMES O. CAVANAUGH	St. Paul, Minn.
HERBERT DAVIS	St. Paul, Minn.
JUSTUS OHAGE, Jr.	St. Paul, Minn.
FRANCIS J. SAVAGE	St. Paul, Minn.
HENRY E. COMBACKER	Osceola, Wis.
LEON C. COMBACKER	Osceola, Wis.
HORACE G. MURDOCK	Taylors Falls, Minn.
RAYMOND G. ARVESON	Frederic, Wis.
HERBERT B. CROMMETT	Amery, Wis.
CLARK C. POST	Barron, Wis.
OLAF M. SATTRE	Rice Lake, Wis.
WALTER F. O'CONNOR	Ladysmith, Wis.
WILLIAM L. STEPHENSON	Ladysmith, Wis.
JULIAN C. BAKER	Hawkins, Wis.
THOMAS B. MCINDOE	Rhinelander, Wis.
CLAYTON H. CHARLES	Goodman, Wis.
GEORGE BJORKMAN	Gladstone, Mich.
ANDREW NELSON	Manistique, Mich.
FREDERICK TOWNSEND	Sault Ste. Marie, Mich.
WESLEY TOWNSEND	Sault Ste. Marie, Mich.

MINNESOTA DIVISION

JOHN J. CATLIN.....Buffalo, Minn.
ALFRED M. RIDGWAY.....Annandale, Minn.
THURSTON W. WEUM.....South Haven, Minn.
GEORGE E. SHERWOOD.....Kimball Prairie, Minn.
FRANK T. BRIGHAM.....Watkins, Minn.
PIERRE C. PILON.....Paynesville, Minn.
WILLIAM S. HITCHINGS.....Belgrade, Minn.
CARL A. FJELSTAD.....Glenwood, Minn.
FLETCHER W. POWERS.....Barrett, Minn.
WILLIAM R. HAND.....Elbow Lake, Minn.
NEWTON H. GREENMAN.....Fairmount, N. D.
VICTOR A. YOUNG.....Hankinson, N. D.
LAROY H. LARBITT.....Enderlin, N. D.
LUDWIG S. PLATOU.....Valley City, N. D.
ALEXANDER W. MACDONALD.....Valley City, N. D.
OTTO W. MCCLUSKY.....Carrington, N. D.
FREDERICK A. DOUGLAS.....Fessenden, N. D.
IRA D. CLARK.....Harvey, N. D.
ADOLPH O. AAKER.....Velva, N. D.
ALEXANDER J. MCCANNEL.....Minot, N. D.
IVER C. J. WIIG.....Kenmare, N. D.
FRED EWING.....Kenmare, N. D.
BLAKE M. LANCASTER.....Crosby, N. D.
ARTHUR J. SOMERS.....Portal, N. D.
CYRUS N. CALLENDER.....Fargo, N. D.

MISSOURI RIVER DIVISION

NICHOLAS J. SHIELDS.....Lidgerwood, N. D.
FREDERICK W. MAERCKLEIN.....Oakes, N. D.
FERDINAND G. BENN.....Kulm, N. D.
GEORGE GRANT.....Wishek, N. D.
COLIN C. CAMPBELL.....Ashley, N. D.
FREDERICK B. STRAUSS.....Bismarck, N. D.
WILLIAM P. THELEN.....Wilton, N. D.
ALLAN SAMUEL NICHOLSON.....Max, N .D.

WINNIPEG DIVISION

WILLIAM E. ELLIS.....Alexandria, Minn.
JACOB L. HOFFMAN.....Henning, Minn.
LEONARD C. WEEKS.....Detroit, Minn.
OSCAR F. MELLBY.....Thief River Falls, Minn.
THEODOR BRATRUD.....Warren, Minn.
WILLIAM F. SIHLER.....Devils Lake, N. D.
CHARLES JOSEPH MCGURREN.....Devils Lake, N. D.
FREDERICK O. GRONVOLD.....Adams, N. D.
EDWARD R. LINDNER.....Egeland, N. D.
WILFRED A. PLOURDE.....Overly, N. D.

DULUTH AND SUPERIOR TERMINALS

CHARLES A. STEWART.....Duluth, Minn.
CHARLES F. MCCOMB.....Duluth, Minn.
DANIEL D. MURRAY.....Duluth, Minn.
CLARENCE E. LUM...Oculist.....Duluth, Minn.
H. JEFFERSON O'BRIEN.....Superior, Wis.
FRANK C. SARAZIN.....Superior, Wis.

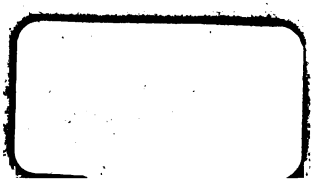
DULUTH-SUPERIOR DIVISION

FRANKLIN R. WALTERS.....Moose Lake, Minn.
IRA M. ROADMAN.....Onamia, Minn.
JOHN J. RATCLIFFE.....Aitkin, Minn.
WILLIAM REID.....Deerwood, Minn.
ALVIN C. TANNER.....McGregor, Minn.
ROWLAND GILMORE.....Bemidji, Minn.
COURTLAND R. SANBORN.....Bemidji, Minn.
JOHN T. BOWERS.....Gully, Minn.

CHICAGO DIVISION—Southern District

GEORGE F. THOMPSON	Chicago, Ill.
JOHN M. DODSON	Chicago, Ill.
FREDERICK S. HARTMANN	Chicago, Ill.
ARTHUR M. PURVES	Des Plaines, Ill.
CLARENCE A. EARLE	Des Plaines, Ill.
HENRY A. BENZ	Wheeling, Ill.
JOHN L. TAYLOR	Libertyville, Ill.
EDWARD F. SHAFFER	Grays Lake, Ill.
LEVIN N. HICKS	Burlington, Wis.
ALBERT J. HODGSON	Waukesha, Wis.
RICHARD E. DAVIES	Waukesha, Wis.
JOSEPH F. QUIN	Milwaukee, Wis.
ARTHUR T. HOLBROOK	Milwaukee, Wis.
JOHN J. MCGOVERN	Milwaukee, Wis.
JOHN STEELE BARNES, Oculist	Milwaukee, Wis.
JOSEPH P. STOYE	Theresa, Wis.
STEPHEN E. GAVIN	Fond du Lac, Wis.
LLEWELLYN A. BISHOP	Fond du Lac, Wis.
JONAS R. LONGLEY	Fond du Lac, Wis.
GEORGE F. SCHEIB, Oculist	Fond du Lac, Wis.
ALBERT J. PULLEN	North Fond du Lac, Wis.
GEORGE M. STEELE	Oshkosh, Wis.
F. GREGORY CONNELL	Oshkosh, Wis.
THOMAS P. RUSSELL	Oshkosh, Wis.
ADDISON J. PROVOST, Oculist	Oshkosh, Wis.
JAMES R. BARNETT, JR.	Neenah, Wis.
EDMUND C. DOLLARD	Neenah, Wis.
WILLIAM G. KEMPER	Manitowoc, Wis.
PETER J. CHRISTOFFERSON	Waupaca, Wis.
LEVI H. PELTON	Waupaca, Wis.
FRANK R. BORDEN	Plainfield, Wis.
BYRON MEACHER	Portage, Wis.

CHICAGO DIVISION—Northern District

ELLIETSON H. ROGERS	Stevens Point, Wis.
CARL VON NEUPERT, SR.	Stevens Point, Wis.
JOHN C. HAYWARD	Marshfield, Wis.
VICTOR A MASON	Marshfield, Wis.
DANIEL R. FREEMAN	Colby, Wis.
GILBERT B. JOHNSTON	Abbotsford, Wis.
HOWARD C. FICKES	Owen, Wis.
CHARLES H. ERDMAN	Stanley, Wis.
EUGENE P. ELLENSON	Chippewa Falls, Wis
JOHN V. R. LYMAN	Eau Claire, Wis.
CHRISTIAN MIDELFART	Eau Claire, Wis.
JOHAN MATHIESEN	Eau Claire, Wis.
WILLIS H. PARK	Glenwood City, Wis.
OTIS H. EPLEY	New Richmond, Wis.
FRANK S. WADE	New Richmond, Wis.
GEORGE W. MCCARTHY	Athens, Wis.
CONRAD E. NYSTRUM	Medford, Wis.
GEORGE C. WICHMAN	Rib Lake, Wis.
WILLIS P. SPERRY	Phillips, Wis.
CHARLES D. FENELON	Phillips, Wis.
EDWIN A. RILEY	Park Falls, Wis.
WALTER G. LAW	Glidden, Wis.
CARL W. LOCKHART	Mellen, Wis.
DAVID C. PIERPONT	Ironwood, Mich.
JOHN H. URQUHART, Oculist	Ironwood, Mich.
R. AUGUST PARADIS	Bessemer, Mich.
JOHN M. DODD	Ashland, Wis.
MATTHEW S. HOSMER	Ashland, Wis.

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